VOL. 6 NO. 20
October 31, 1981

Energy Research Abstracts

ABSTRACTS 29765-31528

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications which are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the energy data base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following: programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $4.00, foreign $5.00 per copy; annual cumulative index, domestic $6.00, foreign $7.50 per copy. The annual subscription price is $44.00 for domestic subscribers and $55.00 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. Indexes are cumulated semiannually and annually. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues including a semiannual index and an annual index is $184.00 for domestic subscribers and $230.00 for foreign subscribers. The semiannual and annual indexes will also be available separately to subscribers. The cost for the semiannual index is $18.00 (domestic) or $22.50 (foreign); the annual index is $33.00 (domestic) or $41.25 (foreign). A single issue costs $5.55 (domestic) or $6.95 (foreign).

The following publications are available to the public on a subscription basis from the National Technical Information Service (NTIS), Springfield, Virginia 22161. The annual subscription rate for one volume (calendar) year (12 issues plus cumulative index) is $45.00 for domestic subscribers and $90.00 for subscribers outside the North American Continent. A single issue is $6.00 (domestic) and $12.00 (outside the North American Continent).

Current Energy Patents (CEP)

A monthly publication providing abstracting and indexing coverage of the international patent literature, including patent applications, that concerns any aspect of energy production, conservation, and utilization. Available as PB81-902800.

Energy Conservation Update (ECU)

A monthly abstract journal devoted to current information on energy conservation in buildings, transportation and propulsion, and industry; waste processing plants and equipment; energy storage; energy conversion; advanced automotive systems; combustion systems; power cycles; synthetic fuels; and power transmission. Available as PB81-914800.

Energy and the Environment (EAE)

A monthly abstract journal devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment. Available as PB81-914900.

Fossil Energy Update (FEU)

A monthly abstract journal devoted to information on the processing and use of fossil fuels. Available as PB81-914600.

Fusion Energy Update (CFU)

A monthly abstract journal devoted to information on controlled thermonuclear research. Available as PB81-915300.

Geothermal Energy Update (GEU)

A monthly abstract journal devoted to information on the exploration and development of geothermal resources. Available as PB81-914700.

Solar Energy Update (SEU)

A monthly abstract journal devoted to information on the utilization of solar, tidal, and wind energy. Available as PB81-914500.

Synthetic Fuels Update (SFU)

A monthly abstract journal devoted to information on coal gasification; coal liquefaction; other coal processing; biomass conversion to fuel; shale oil and tar sand bitumen production; hydrogen fuels; other hydrocarbon fuels; alcohol fuels; and inorganic hydrogen compound fuels. Available as PB81-902700.

INTERNATIONAL ENERGY PUBLICATIONS

Atomindex (Published in cooperation with the Technical Information Center by the International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria)

A semimonthly abstract journal devoted to information on nuclear science and technology. Through an exchange agreement, IAEA/INIS provides all non-U. S. nuclear information of *Atomindex* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. nuclear information to IAEA/INIS for inclusion in *Atomindex*. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Coal Abstracts (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

A monthly abstract journal devoted to information on coal. Through an exchange agreement, IEA Coal Research provides all non-U. S. coal information of *Coal Abstracts* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. coal information to IEA Coal Research for inclusion in *Coal Abstracts*. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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Editor's Note

Printed cumulative indexes will be prepared for *Energy Research Abstracts (ERA)*, Volume 6 for 1981. The Volume 7, 1982 subscription will provide the 24 semi-monthly issues only. No printed cumulative indexes will be prepared for *ERA*, Volume 7, 1982. For those not making use of one or more of the on-line systems, TIC expects to make available a microfiche version of *ERA* annual indexes for Volume 7. Sources and prices for these microfiche will be announced at a later date.

With Volume 7, the coverage of *Energy Research Abstracts* will be broadened to announce all unclassified, publicly available reports processed by the Technical Information Center. This coverage increase will result in the inclusion of 10,000 additional abstracts. Discontinuance of the cumulative indexes will offset the cost of this additional coverage.

The total content of *ERA* is maintained on a continuing basis in the Energy Data Base (EDB). EDB is available for searching via the DOE/RECON on-line system and is also available commercially via Bibliographic Retrieval Service (BRS). Commercial availability via Dialog and Orbit will be added in the fall. This widespread availability of constantly cumulating indexes to *ERA* information decreases the usefulness of printed cumulative indexes to an impractical level.

The editorial staff believes its decision to rely on computerized systems for retrospective searching is both forward thinking and cost-effective. It is expected that any inconvenience to *ERA* users will be minimal.

Dave E. Bost

ERRATA

Vol.	Issue	Replace Bibliographic Citation with:
6	2	**2164** (CONF-7808128–1) **Potentialities of forest biomass as sources of energy.** Brown, C.L. (Georgia Univ., Athens (USA). School of Forest Resources). 1978. Contract AS09-76ER00888. 13p. NTIS, PC A02/MF A01.
6	5	**6008** (SERI/CP–635-938) **SERI second wind energy innovative systems conference.** (Solar Energy Research Inst., Golden, CO (USA)). 1980. Contract AC02-77CH00178. 225p. (CONF-801223-(Vol. 1)). NTIS, PC A10/MF A01.
6	7	**8900** (DOE/SF/20235–T1(Vol.4)) **Current-wave spectra coupling project. Volume IV. Part A. Formulation of the three-dimensional structure of storm-generated currents. Part B. Summaries of Volumes I, II and III.** Venezian, G.; Bretschneider, C.L. (Hawaii Univ., Honolulu (USA). James K.K. Look Lab. of Oceanographic Engineering). Sep 1980. Contract AT03-76SF20235. 45p. NTIS, PC A03/MF A01.
6	9	**12549** (DOE/NASA/0092–80/1) **Advanced propulsion system concept for hybrid vehicles.** Bhate, S.; Chen, H.; Dochat, G. (Mechanical Technology, Inc., Latham, NY (USA). Stirling Engine Systems Div.). Dec 1980. Contract AI01-77CS51044. 168p. (NASA-CR–159772; MIT–80TR25). NTIS, PC A08/MF A01.
6	13	**18826** (DOE/CS/20066–T1) **Occupancy-counter-based control system. Final report.** Schultz, G.; Hoagland, L.C.; Bowman, J.K. (Advanced Mechanical Technology, Inc., Newton, MA (USA)). Jul 1979. Contract AC02-77CS20066. 139p. NTIS, PC A07/MF A01.
6	13	**18959** (DOE/NASA/2593–26) **Burner-rig evaluation of thermal barrier coating systems for nickel-base alloys.** Gedwill, M.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Feb 1981. Contract AI01-77ET10350. 25p.(NASA-TM–81684). NTIS, PCA02/MF A01.
6	15	**22140** (DOE/CS/56051–3) **Ethanol energy yield per gallon and potential petroleum displacement.** (Mueller Associates, Inc., Baltimore, MD (USA)). May 1981. Contract AC05-79CS56051. 27p. NTIS, PC A03/MF A01.
6	16	**23675** (CONF-800617–9) **Heat-transfer scaling laws for MHD radiant boilers.** Im, K.H.; Ahluwalia, R.K. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Technical Information Center, as the national information center for the Department of Energy, manages, publishes, and disseminates scientific, technical, and practical energy information acquired from worldwide sources. It builds and maintains energy information data bases used to prepare abstracting journals, bibliographies, and literature searches. The data bases are also searchable via the Department's on-line retrieval system, DOE/RECON. This information is provided to DOE program offices and contractors; scientists; engineers; educational, commercial, and industrial communities; and the general public. The Technical Information Center conducts an active announcement and marketing program. It establishes policy and administers control of an inventory and registry for DOE publications. The Center also develops and evaluates new and effective information systems and services as required by scientific and technical management within the Department of Energy.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, conservation, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Federal, state, and municipal agencies concerned with energy development, conservation, and usage may obtain *ERA* free of charge. Inquiries should be directed to the Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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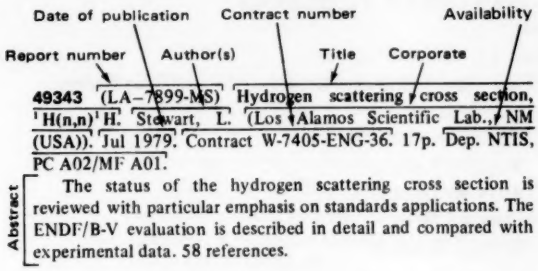
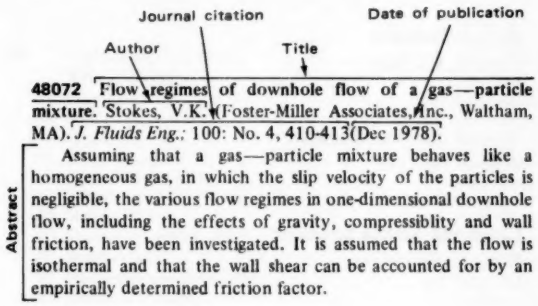
•ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Date of publication
Contract number
Availability
Report number
Author(s)
Title
Corporate
49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.


Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.: 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

•INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

•Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. **(Los Alamos Scientific Lab., NM (USA))**. Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)

•Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

•Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles and informative phrases, or both, specific to these entries are arranged alphabetically under the entries.

HYDROGEN I TARGET
Neutron Reactions
Hydrogen scattering cross section, ¹H(n,n)¹H (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY
Research Programs
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, 96*th* Congress, 4:48749.

•Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	Los Alamos Scientific Lab., NM (USA)	
	3:49698	LA-tr–78-45
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	3:49863	LA–7235-MS
W-7405-ENG-48	California Univ., Livermore (USA). Lawrence Livermore Lab.	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	4:49343	Dep. NTIS, PC A02/MF A01
LA-tr-		
78-69	4:48158	Dep. NTIS, PC A03/MF A01

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Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

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29765 (DOE/ET/13060—T3(Vol.23)(Bk.1)) Pipeline-gas Demonstration Plant. Phase I: Demonstration Plant engineering and design. Volume 23, Book 1: Plant Section 4100 - Buildings. (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). [nd]. Contract AC01-77ET13060. 142p. (FE—2542-38(Vol.23)(Bk.1)). NTIS, PC A07/MF A01. Order Number DE81028559.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to be completed in June 1981. One of the major efforts of Phase I is the process and project engineering design of the Demonstration Plant. The design has been completed and is being reported in 24 volumes. This is Volume 23 - Book 1, which reports the design of Plant Section 4100 - Buildings. There are five buildings included in the Demonstration Plant: (1) Administration Building; (2) Maintenance/Warehouse Building; (3) Gate/Change House; (4) Firehouse/First Aid/Laboratory; and (5) Control House. All buildings were designed and will be constructed to meet state and local building codes. Current energy conservation technology was incorporated into the designs.

29766 Development of a noninvasive acoustic leak detection system for large high pressure gas valves. Shack, W.J.; Ellingson, W.A.; Youngdahl, C.A. (Argonne Natl Lab, USA). *ISA (Instrument Society of America) Transactions ;* **19**: No. 4, 65-71(1980).

Coal-conversion plants for the production of clean gaseous and liquid fuels operate at high pressures (approx. 50-60 atm) and high temperatures (approx. 1000/degree/C). Coal feed and ash letdown systems for such processes generally require the use of intermediate pressurized lockhopper systems which are isolated from the process vessel by large diameter (10-50 cm) valves which must be able to maintain large pressure differences during portions of the feed or letdown cycle. This paper describes laboratory and field studies leading to the development of an on-line noninvasive acoustic leak-detection system for such valves. The system is based on the detection and characterization of acoustic emissions generated in a valve body by turbulent flow existing from a leakage channel in the valve caused by wear during normal operation. The theoretical background for such a system is presented, and the theoretical predictions are compared with experimental measurements for flows through orifices of different sizes and cross-sections. Preliminary correlations of acoustic output with leakage rates for typical large valves are presented. 10 refs.

29767 Process for gasifying carbonaceous material from a recycled condensate slurry. Forney, A.J.; Haynes, W.P. (to Department of Energy). US Patent 4,244,706. 13 Jan 1981. Filed date 10 Sep 1979. vp.

PAT-APPL-074352.

Coal or other carbonaceous material is gasified by reaction with steam and oxygen in a manner to minimize the problems of effluent water stream disposal. The condensate water from the product gas is recycled to slurry the coal feed and the amount of additional water or steam added for cooling or heating is minimized and preferably kept to a level of about that required to react with the carbonaceous material in the gasification reaction. The gasification is performed in a pressurized fluidized bed with the coal fed in a water slurry and preheated or vaporized by indirect heat exchange contact with product gas and recycled steam. The carbonaceous material is conveyed in a gas-solid mixture from bottom to top of the pressurized fluidized bed gasifier with the solids removed from the product gas and recycled steam in a supported moving bed filter of the resulting carbonaceous char. Steam is condensed from the product gas and the condensate recycled to form a slurry with the feed coal carbonaceous particles.

29768 (BNL—29825) Dehydrogenation/hydrogenation reactions in hydroaromatic systems. Gangwer, T. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 6p. (CONF-810914—3). NTIS, PC A02/MF A01. Order Number DE81027667.

From International conference on coal science; Dusseldorf, F.R. Germany (7 Sep 1981).

The basic chemistry of the donor solvent dehydrogenation/hydrogenation process is an important component of liquefaction to understand. Kinetic and mechanistic work on the hydroaromatic donors: tetralin (T), 1,2-dihydronaphthalene (DN) and 9,10-dihydroanthracene (DA) is yielding insight into this chemistry. The chemistry of the dehydrogenation/hydrogenation reactions in the neat donor solvent systems has been found to be heterogeneously controlled. The composition of the product mixtures are sensitive to the initial density of the hydroaromatic reactant. As the reactant density increases, the tetralin product mix changes from 1,2-dihydronaphthalene/naphthalene (N) to methylindane (M)/naphthalene. For the 9,10-dihydroanthracene system anthracene (A) is a major product but the yield of 1,2,3,4-tetrahydroanthracene (TA) increases as the initial reactant density is increased. Reaction mechanisms for these hydroaromatic systems are proposed which describe the observed dehydrogenation/hydrogenation processes in terms of reversible heterogeneous site reactions. Based on kinetic studies, a general reaction mechanism has been developed which describe the observed reactant/product sequences. Results of the kinetic and mechanistic investigations of these systems are presented. Conclusions are as follows: the hydrogenation/dehydrogenation reactions of the hydroaromatic systems studied can be modeled using the proposed heterogeneous reaction mechanism; the dihydro-reactants can react along more than one pathway; and the extent of reaction for these different pathways is a function of the hydrogen content of the heterogeneous surface.

29769 (CONF-800716—) Sixth underground coal-conversion symposium. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center; Williams Bros. Engineering Co., Tulsa, OK (USA)). 1980. 619p. NTIS, PC A99/MF A01. Order Number DE81027669.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

The sixth annual underground coal conversion symposium was held at Shangri-la near Afton, Oklahoma, July 13 to 17, 1980. Sessions were developed to: Doe Field Programs, Major Industry Activity, Mathematical Modeling, Laboratory Studies, Environmental Studies, Economics, Instruments and Controls, and General Topics. Fifty-two papers from the proceedings have been entered individually into EDB and ERA. Thirteen papers had been entered previously from other sources. (LTN)

29770 (CONF-800716—, pp I.1-I.4) Department of Energy underground coal conversion program accomplishments and strategy. Burwell, E.L. (Dept. of Energy, Washington, DC). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

The ability to produce low or medium Btu gas by underground coal gasification has been demonstrated through 17 field tests in the United States in the past seven years. Twelve of these were by DOE and five by industry. Projected advantages such as lower costs, environmental acceptability, and the conversion of tremendous quantities of resources to reserves appears more certain. Numerous factors have combined to require a more focused national UCG program. The strategy selected is for the production of medium Btu gas for conversion to liquid transportation fuels, for conversion to synthetic natural gas, or for direct burning for power generation or industrial heat.

29771 (CONF-800716—, pp I.4-I.7) **DOE Underground Coal Conversion program implementation: structure and plans.** Jiacoletti, R.J. (Laramie Energy Technology Center, WY). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

The implementation plan for the Department of Energy (DOE) Underground Coal Conversion (UCC) program is discussed. The management plan and the program rationale are presented. The planned program contains two elements: A technology base development element and a Government/industry cooperative projects element. The activities in the technology base development element of the program will focus the ongoing programs of the present participants into a single, combined programmatic effort to resolve the technical problems of the UCC process in the most cost-effective and timely manner. The Government/industry cooperative projects element will be implemented in an appropriately scaled and phased series of progressively larger and/or more complex field projects, culminating in a commercial sized module or an equivalent. The interaction between the program elements is discussed and the phased plan for Government/industry cooperative projects in both flat-lying and steeply dipping beds of subbituminous coals is described.

29772 (CONF-800716—, pp I.8-I.18) **Successful underground coal gasification field test in a thin seam, swelling eastern bituminous coal.** Martin, J.W.; Liberatore, A.J. (Morgantown Energy Technology Center, WV). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Under the direction of the Morgantown Energy Technology Center of the Department of Energy (DOE) a 900 ft (275 m) deep, 6 ft (2 m) thick, high swelling, eastern bituminous coal has been gasified successfully in situ. Pricetown I, a relatively small scale field test of the Linked Vertical Well Technology, affected the equivalent of about 735 tons (665 t) of coal during the four month test in a high sulfur, high ash flat lying seam of the Pittsburgh Coal near Pricetown, Wetzel County, West Virginia. A methane and hydrogen rich gas with a heating value averaging in excess of 200 Btu/cf (7450 kJ/m^3) was produced at low flow rates during reverse combustion linkage operations to enhance coal seam permeability. In the 12 day high flow gasification phase, coal was consumed at 25 to 32 tons/day (23 to 29 t/d) to produce a gas with an average heating value of 124 Btu/cf (4260 kJ/m^3) resulting in an average energy production of 511 MMBtu/day (539 GJ/d). Test operations and initial test results are described using minimally corrected raw test data and plans for the continued development of this alternative energy source are discussed.

29773 (CONF-800716—, pp I.30-I.40) **Summary report of the Rawlins Test 1 for gasification of steeply dipping coal beds.** Singleton, A.H. (Gulf Research and Development Co., Pittsburgh, PA); Noll, W.L.; Allen, J.M. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Gulf Research and Development Company has entered into a contrast with the Department of Energy (DOE) for the gasification of steeply dipping coal beds. The test facility is described and results of the first test discussed on the basis of defined test objectives. Rawlins No. 1 was a success. Essentially all the objectives were met and much was learned about conducting the more complex Rawlins No. 2 field test. The test was designed to investigate the effects of water/air injection, steam/air injection, and steam/oxygen injection.

29774 (CONF-800716—, pp II.1-II.10) **Linking study at great depth.** Ledent, P.; Beckervordersandforth, C.P.; Chandelle, V. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

The preparation works of the first Belgo-German experiment of underground coal gasification are going on. The experiment will take place in Belgium, on the Thulin site, in a bundle of seams lying at a depth of 860 m and which contains about 4 m of coal distributed over several layers. Within the framework of this preparation, we have been carrying out for 4 years, in the underground workings of four Belgian coal-mines, lying at depths ranging from 750 to 1,250 m, a series of tests aiming at measuring the permeability of the virgin seams and at investigating the possibility to establish a linking between two intersecting boreholes, 40 to 80 m apart. It is intented to present the results of these tests which confirm the very low permeability of the coal seams lying at great depth, but which also show that it is possible for important air flows to circulate in these seams thanks to the utilization of very high pressures.

29775 (CONF-800716—, pp II.11-II.24) **Industrial approach to UCG facility design and construction.** Bailey, D.W. (Gulf Research and Development Co., Lakewood, CO); Gregory, J.L. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Gulf Research and Development Company recently completed the first field test in the US of underground coal gasification in steeply dipping subbituminous coal beds at a site near Rawlins, Wyoming. The test was the first sponsored by the US Department of Energy fielded by a major energy company, and was run using a facility designed, engineered and constructed in accordance with commercial industry practice. The design criteria used for the facility are described together with a comprehensive review of the piping and instrumentation used at the site. The results of the plant operation are reviewed with proposed design changes to be incorporated in subsequent test facilities based upon the Rawlins I test experience.

29776 (CONF-800716—, pp II.25-II.33) **Gas cleanup problems for low and medium heating value gas which are unique to UCG.** Montagna, J.C. (Gulf Research and Development Co., Pittsburgh, PA). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Although the general characteristics of the UCG produced LHV and MHV product gas are similar to those of surface gasifier products, the cleanup and upgrading of the product will require some new technology. The UCG product from each module is expected to vary with time as the underground coal cavity grows and as conditions in the cavities experience shorter range readjustments (e.g., roof cave-ins). These process condition variations will cause the composition of the major products (CO, H_2, and CH_4) and minor products (solids and condensibles) to vary with time. The logistics of a dynamic underground multi-reactor system located possibly several miles from the main plant dictate that some physical cleanup of the product be performed near each reactor. The yet to be developed technology for field cleanup will be mobile and will sufficiently clean the raw product UCG gas to ensure the necessary reliability of a commercial operation for the combined gas gathering and plant processing system. Of the several clean-up strategies presented, the more conventional approach to field clean-up is a sequential removal of: solids at product temperature, heavy hydrocarbons as the product temperature is lower to ca. 250°F and lighter hydrocarbons and moisture as the product temperature is lowered to ~ 100°F. In this concept the sensible heat of the product gas is exchanged with the UCG injection gases. The experimental part of Phase I of this program is described in which process oriented sampling and characterization of product gas contaminants from the Rawlins UCG air and oxygen blown tests is being carried out.

29777 (CONF-800716—, pp II.38-II.39) **Possible application of telechiric mining methods to underground coal gasification (UCG).** Balfour, A.E. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Remote control techniques are continually being developed in conventional deep mining of coal in Great Britain. The aim is to minimise the more hazardous and unpleasant tasks of men working underground and the ultimate ideal would be to eliminate the need for men to go underground at all. It is suggested that these techniques might be developed to prepare underground arrays for in situ gasification, particularly to overcome the problem of making positive and reliable linkages between boreholes in the coal seam.

29778 (CONF-800716—, pp II.59-II.63) **Major environmental and sociopolitical issues to be resolved before UCG is commercialized.** McSparran, D.K.; Follick, J.H.; Tate, J. Jr. (ARCO Coal Co., Denver, CO). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

ARCO Coal Company has initiated a major development program aimed at bringing underground coal gasification technology to commercialization before 1990. For this to occur, a number of technical, environmental, sociopolitical and economic issues must be resolved. This paper discusses the environmental and sociopolitical concerns raised by underground coal gasification technology and the regulatory constraints which will inhibit commercial development. ARCO Coal's views on the basis for resolution of these issues are presented. Our approach to subsidence, groundwater effects, air pollution control, reclamation and other related subjects is discussed. ARCO Coal is committed to developing solutions to these problems so that underground coal gasification technology can be commercialized expeditiously in order to help meet the nation's energy needs.

29779 (CONF-800716—, pp III.1-III.14) **Mathematical modeling of linked vertical well in situ coal gasification.** Gibson, M.A. (Exxon Research and Engineering Co., Baytown, TX); Pennington, R.E.; Wheeler, J.A. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

A mathematical model of the linked vertical well process has been developed and successfully tested against field data. Opposed heat and mass transfer in the cavity wall and water influx are explicitly modeled. The model also includes the effect of decrepitation along the linkage path. Process sensitivies to both physical parameters and process variables can be estimated with the model. For example, air injection rate and cavity pressure strongly influence cavity temperature which determines cavity growth rate. The model cannot represent variable injection conditions and does not exactly treat growth of the cavity into the linkage path. Application of the model is limited by available experimental data particularly low temperature kinetic data and high temperature thermal properties.

29780 (CONF-800716—, pp III.15-III.20) **Prediction of product gas composition for UCG.** Natarajan, R. (Univ. of Texas, Austin); Edgar, T.F.; Savins, J.G. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

The accurate prediction of product gas composition for a variety of conditions in underground coal gasification is crucial to evaluating the economics of low and medium Btu gasification as well as a useful tool for analyzing field data. The key parameters affecting gas composition are coal composition, carbonization assay, water influx, steam injection, coal moisture content, pressure, injection temperature, and environmental heat loss to rock strata. Sensitivity studies on syngas product distributions for in situ gasification of Texas lignite are reported. The model has been successfully compared with field data. The following points are apparent from simulation runs: (1) increased water influx leads to a poorer product gas in terms of heating value, and lowered the production of gas, much more so than for adding the same amount of steam; (2) increased strata heat losses have the same effect; (3) in the case of pure oxygen or air injection, there is an optimum water influx rate; (4) methane production is decreased by air injection, due to the lowering of hydrogen partial pressure. However, the major methane contribution, over 90%, is from carbonization.

29781 (CONF-800716—, pp III.21-III.31) **Water-influx model for UCG.** Krantz, W.B. (Univ. of Colorado, Boulder); Camp, D.W.; Gunn, R.D. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

A water-influx model is developed which incorporates two principal mechanisms: unsteady-state radial permeation, and spalling-enhanced drying of the overlying coal and overburden. These mechanisms are coupled via a cavity growth model. The model predictions follow the general trends for the daily average water influx for the Hanna II Phases II and III, Hanna III, and Hoe Creek II UCG field tests, and predict the water influx for the total duration of each of these four tests with an average error of 13.1 percent. The model indicates that the water influx per unit mass of coal consumed increases as the seam thickness decreases or as the reverse-combustion link is completed progressively higher in the seam. A UCG operating strategy is suggested whereby the water influx per unit mass of coal consumed can be maintained nearly constant. Since the components of this comprehensive water-influx model are analytical, the resulting Fortran program is very simple, efficient, and inexpensive to run.

29782 (CONF-800716—, pp III.32-III.39) **Numerical simulation of an in situ filtration gasification process.** Krauss, U.; Marzilger, B. (Bergbau-Forschung GmbH, Essen, West Germany). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

The results of numerous field tests carried out up to now show that an in-situ gasification process can be initiated and maintained successfully. Gaining the experience of how to operate the process from bench scale experiments only is limited because in the laboratory many of the boundary conditions prevailing in-situ cannot be simulated adequately. On the other hand, field tests, particularly in deep seams, can be monitored insufficiently only and the process can be analyzed only poorly. Proper control of an in-situ gasification process applied to deep seams is rather difficult. Additionally applying tests to deep seams is costly and the number and the extent of tests is limited by economic reasons. Control of the process has, therefore, to be accomplished carrying out only a minimum number of field trials. Consequently the urgent need for a theoretical understanding of in-situ gasification has become apparent. Thorough interpretation of the test results requires the development of a model. Hence a numerical simulator could be a powerful tool in the development of underground gasification provided that the set of coupled equations, which represents a complete description of the in-situ coal gasification, can be reduced to a tractable form. The two-dimensional model presented allows for transient flow of mass and heat in the coal and is coupled with the chemical reactions. Mass and heat transfer with the surrounding rocks is also included. (LTN)

29783 (CONF-800716—, pp III.40-III.55) **Mathematical study of multiwell underground coal gasification in western coal fields.** Harloff, G.J. (Gulf Research and Development Co., Pittsburgh, PA); Eddy, T.L.; Schwartz, S.H. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

A mathematical study is presented which obtains an estimate of: coal recovery, the appropriate range of operating conditions, and the effect of cavity size and spacing on subsidence for several multiwell patterns in underground coal gasification. The multicavity field test literature is reviewed to select the well patterns modeled. The study considers flow rate variations with time, intersection of cavities, well spacing (length and width), and link zone diameter for a realistic coal site. Ground level subsidence is determined and its impact on well spacing and consequently on resource recovery is evaluated. This study is the first known attempt to model multiwell sweep. At least three constraints must be met in order to develop a reasonably successful commercial operation. First, the heating value of the product gas must be maintained

above a minimum level. Second, the degree of coal recovery due to the gasification should be as high as possible, and third ground subsidence and/or induced horizontal strain should either be minimized or controlled.

29784 (CONF-800716—, pp III.56-III.64) **Method for evaluating the significance of observed variations in underground coal gasification.** Galli, R.D.; Jones, G.E.; Kiviat, F.E. (Gulf Research and Development Co., Pittsburgh, PA). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Product gas heating value and composition fluctuate during steady state operation of an underground coal gasification module. We modelled such fluctuations with a one-dimensional process model imbedded in a Monte Carlo simulator. Variation of model input parameters such as groundwater flow rate or fractional heat loss can explain most observed short term variations of process output variables. On the other hand, variation in coal proximate analysis (although commensurate with coal proximate analysis variation in the seam) only explains some of the observed variations in the process results. In this paper, we describe the model, present results, and suggest uses of this technique which include: (1) given an observed variation in some resultant from a process, one can use this technique to estimate quantitatively what variations in process input might generate the observed output variations; (2) alternatively, given known variations in one or more process inputs, one can use this technique to calculate what output variations should be expected.

29785 (CONF-800716—, pp III.65-III.68) **Hot gas drying calculations for a coal seam channel.** Kashiwa, B.A.; Harlow, F.H. (Los Alamos National Lab., NM). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Coal seam permeability enhancement due to the drying effects of hot gases is an essential part of Underground Coal Conversion (UCC) of low rank coals. An understanding of the process by which coal seam flow impedance is reduced can be useful in seam characterization as well as UCC performance prediction. In this paper a single, low-flow-impedance channel is considered. Calculations show the temperature and saturation profiles for the channel and the coal bordering the channel for both plane and cylindrical geometries. These calculations are the first steps in a systematic program to develop useful thermodynamic and fluid dynamic analysis modules for assembly into an accurate theoretical model of UCC processes. Later steps will include more complex flow conditions in the channel, changing channel size, and systems of channels.

29786 (CONF-800716—, pp III.69-III.83) **Simple UCG cavity model with complex energy balance.** Schwartz, S.H. (California State Univ., Northridge); Eddy, T.L.; Nielsson, G.E. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

The side wall burn UCG cavity model has been extended to include a complex energy balance. Wall, reaction and bulk or gas zones are considered with convective heat transfer between the wall and gas zones, as well as wall to wall radiation if the gas is optically thin. All these calculations predict small differences between wall and gas temperatures throughout the cavity and decreasing temperatures with time. Convection with or without optically thick radiation results in much higher temperatures near the injection well. Optically thin radiation within the cavity equilibrates the temperatures throughout the cavity. Results from the parametric study with Pittsburgh coal in a 6 ft thick coal seam showed that the wall and gas temperatures dropped appreciably with time as more of the overburden and underburden became exposed. For the same reason, increasing flow rates and decreasing seam thicknesses result in lower temperatures. Since the temperature decreases with time, the amount of water which can react with the coal also decreases. A drop in the heating value with time was also found which is in general agreement with field test results. The Hanna II, Phase II, field test was simulated with the same model using western coal properties and Hanna operating conditions. The predicted cavity width was close to that of the estimated Hanna cavity although some differences in the general cavity shape were found.

29787 (CONF-800716—, pp III.84-III.96) **Development and application of a three-dimensional in situ coal conversion simulator.** Kossack, C.A. (ARCO Oil and Gas Company, Dallas, TX). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

A three-dimensional, four-phase in situ coal conversion simulator is described which rigorously models fluid flow, heat transfer, vaporization/condensation, combustion gasification, pyrolysis, drying, and coal property changes. An initial version of the simulator is detailed which has five fluid components - water, oxygen, tar, nitrogen, and a product gas. The paper presents the physical/chemical mechanisms which are modeled, the comprehensive mathematical solution, and two sample applications of the simulator to the Hanna Field tests. The applications demonstrate the current capability and future potential of the simulator to interpret field results and predict the sensitivity of field performance to reservoir characteristics and field operating procedures. Additional features currently being implemented in the model are described which will enable the simulator to more accurately model the entire process.

29788 (CONF-800716—, pp IV.1-IV.8) **Combustion tube for UCG process variable studies.** Wolcott, H.B. Jr. (ARCO Oil and Gas Company, Dallas, TX). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

This paper describes a laboratory coal combustion tube which has been built to obtain data for testing computer models and interpreting underground coal gasification field test results. The tube can be used to study the effect of the following process variables: gas mass velocity, water-oxygen ratio, carbon dioxide-oxygen ratio, oxygen mass velocity, and particle size. It can be operated in forward or reverse combustion at pressures up to 68 atmospheres and temperatures to 2000°F. Axial conduction and storage of heat in the vessel wall are minimized by using a thin-wall tube inside a heavy walled pressure shell. The vertical, insulated tube is 6-inch I.D. by 13.25 feet long and is fabricated from 0.35 inch thick Hastelloy alloy X sheet. The coal charge is approximately 100 pounds. Temperatures are measured by thermocouples attached to the tube walls and by a scanning thermocouple which travels along the central axis of the combustion tube. Data logger output (e.g., pressures, temperatures, flow rates) and product gas analyses from an on-line chromatograph are recorded on magnetic tape for computer processing. Results of some preliminary runs are included.

29789 (CONF-800716—, pp IV.9-IV.20) **Pyrolysis properties of Texas lignite under conditions of in situ gasification.** Edgar, T.F.; Hunt, W.C.; Matteson, S.M.; Cadwell, J.A.; Tsang, T.H. (Univ. of Texas, Austin). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

A series of experiments dealing with pyrolysis of Texas lignite have been performed recently at the University of Texas and Oak Ridge National Laboratories. Data have been obtained for the effects of heating rate, particle size, and carrier gas on pyrolysis yields for a range of operating conditions expected for underground coal gasification. Correlation of the data is especially difficult for large particles or blocks because of coupled intra-particle heat and mass transfer and volatiles cracking and self-gasification. Simulation results for a proposed transport model, which agree reasonably well with laboratory data, are presented.

29790 (CONF-800716—, pp IV.21-IV.30) **Pressurized combustion tube gasification of Texas and Wyoming coals.** Rodgers, M.E.; Rajan, R. (Exxon Production Research Co., Houston, TX). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Coal gasification experiments conducted in a pressurized guard-heated combustion tube are described. The experimental facility includes the combustion tube, a pressure containment vessel, and systems for gas and steam injection, multiple independent

guard-heater control, produced liquid collection and measurement, pressure regulation, produced gas metering and analysis, exhaust treatment and disposal, and automatic data acquisition. Texas lignite and Wyoming subbituminous coals were gasified at several rates using oxygen and steam at pressures between 7.8 and 35 atmospheres. Results showed that total gas production and heating value are insensitive to pressure and reactant flux, but gas composition varies with both parameters. Small differences in gasification characteristics were observed between the two coals.

29791 (CONF-800716—, pp IV.31-IV.42) **Adiabatic coal gasification tube experiments - forward combustion.** Bell, G.J.; Gunn, R.D. (Univ. of Wyoming, Laramie). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Results from adiabatic in situ coal gasification tube studies in the forward mode are presented. The reactor and the laboratory configuration are described. Combustion front channelling and the problems of operating the system adiabatically are discussed. Representative gasification data are given and several runs are analyzed for peak combustion temperature, combustion and devolatilization front velocities and production gas flow rate, composition, and heating value. All results are made viable through completion of material and energy balances on the system and radial conductive heat losses are determined. The laboratory results are correlated with the Hanna field tests and with a one-dimensional in situ coal gasification numerical model.

29792 (CONF-800716—, pp IV.43-IV.57) **Experimental and theoretical studies on thermo-structural responses associated with underground coal conversion.** Advani, S.H. (Ohio State Univ., Columbus, OH); Richard, T.G.; Lee, J.K.; Shoemaker, H.D.; Gmeindl, F.D. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Laboratory investigations related to the representation of Pittsburgh bituminous coal and over-burden shale structural properties are reported. Experimental data on compressive, shear, and fracture response is reported along with scanning electron micrograph characterization of the coal and overburden bedding shale layers and related fracture systems. Supporting theoretical investigations on two and three dimensional thermo-mechanical responses associated with elliptical and ellipsoidal cavities are presented. In addition, mechanistic phenomena relating to temperature and stress profiles, subsidence, cavity burn configuration, and thermal cracking are discussed.

29793 (CONF-800716—, pp IV.58-IV.62) **Creep of Texas overburden in relation to underground coal gasification.** Thompson, T.W.; MacKinnon, R.J.; Gray, K.E. (Univ. of Texas, Austin). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

A series of preliminary creep tests have been run on clays overlying Texas lignite. These tests have included short-term uniaxial constant stress tests, cyclical uniaxial loading tests and short-term triaxial drained and undrained tests. The results from these tests indicate that the material exhibits a time dependent response to load which may be attributed to creep mechanisms. A consideration of the effects of these mechanisms on the rock mass behavior above a gasification chamber indicates that they may lead to a reduction of the extent of any roof collapse and hence to surface subsidence. While this behavior may be modelled satisfactorily at single stress conditions by a linear viscoelastic material, the behavior is in fact, nonlinear under varying stresses. The existence of these time dependent mechanisms is significant to the understanding of overburden behavior and should be included in any realistic simulation.

29794 (CONF-800716—, pp IV.63-IV.69) **Gasification of bituminous coal with air and air steam mixture under pressure.** Mohtadi, M.; Kuehn, M.; Franke, F.H.; Gudenau, H.W. (Aachen Univ. of Technology, West Germany). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

In an autoclave plant being conceived for an operating pressure of 60 bar and an operating temperature of 1000°C, tests were carried at coal blocks out with air and air/steam mixtures. In the case of the air steam tests, the converted steam/oxygen ratio was varied to 2.1. In a nomogram the maximum steam quantity was ascertained during underground gasification by means of an energetic estimation. As a result an optimally converted steam/oxygen ratio of 1 is ascertained during autothermal underground coal gasification.

29795 (CONF-800716—, pp IV.70-IV.80) **UCG studies in a large block simulator.** Greenfeld, M. (Alberta Research Council, Edmonton). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Since 1976 the Alberta Research Council has been conducting laboratory simulations of Underground Coal Gasification, utilizing large monolithic subbituminous coal blocks, measuring approximately 81 x 76 x 170 cm (32 x 30 x 67 in) obtained from an underground mine. A horizontal channel and vertical wells 130 cm (51") apart are drilled, and an extensive instrumented reactor is built around the block. Forward (and reverse) gasification is carried out mostly with air, flowrates, 0.08 - 0.7 cu m/min (9 to 25 SCFM) and with water injection (also gas sampling) along the reactor channel. The main purpose of the tests is to study the various phenomena occurring in situ during gasification by achieving the highest possible degree of similarity, under controlled conditions. Gas compositions and the simulator's general behaviour are directly comparable with field test data. Cavity growth and rubble bed formation, override situations, the extent of gasification/pyrolysis reactions and reaction zone propagation associated with three dimensional temperature profiles are presented.

29796 (CONF-800716—, pp IV.87-IV.91) **Coal properties bearing on UCG modelling.** Berkowitz, N. (Univ. of Alberta, Edmonton). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

The impact of rank-, temperature- and time-dependent coal properties on UCG is qualitatively discussed. Particular attention is directed to effects springing from the porosity and thermal decomposition of coal, and from its decomposition products. It is noted that these matters bear on the physical behaviour of the UCG system, as well as, in part, on the equilibria of the primary gasification reactions and on the composition of the product gas.

29797 (CONF-800716—, pp V.1-V.6) **EPA research: in-situ coal gasification results to date.** Thurnau, R.C.; Bates, E.R. (Industrial Environmental Research Lab., Cincinnati, OH). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

EPA's research program in in-situ coal gasification is orientated towards finding any environmental problems at an early stage of development and resolving them so that they are not a deterrent to commercialization. Areas that are potentially troublesome from an environmental standpoint are groundwater contamination, subsidence and air pollution emissions. All of these problems are being addressed by EPA and the current results in those areas are discussed.

29798 (CONF-800716—, pp V.7-V.12) **Environmental monitoring of BRI gasification sites.** Grant, J.F.; Haney, S.E. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Groundwater data from the Big Brown test site and the Tennessee Colony site is presented along with the results of subsurface post gasification studies. In addition, current and future projects are outlined. The Big Brown site was monitored for three years until its closing in the Spring of 1979 while Tennessee Colony has been monitored since prior to ignition in August 1978. The data from the cavity water indicates that the quality of the water is restored to baseline or drinking water standards in approximately three years. The exact vehicles of the cleanup process are unknown but adsorp-

tion and absorption along with bacterial activity is thought to play a large part in the cleanup. Subsidences and roof collapse appear to be negligible but shall be periodically monitored until the site is closed.

29799 (CONF-800716—, pp V.13-V.19) **Hanna IV product gas monitoring.** Magee, R.A.; Mann, R.M.; Kilpatrick, M.P.; Williams, W.A. (Radian Corp., Austin, TX). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Product gas from Underground Coal Gasification was monitored during the Hanna IV UCG Test conducted by the Laramie Energy Technology Center. The monitoring was designed to provide both process development and environmental data to define the requirements for product gas clean-up prior to end use. During two series of test runs, one in the Spring of 1978 and the other in late summer of 1979, the product gas was monitored on a weekly basis for particulate loading and size distribution, trace nitrogen and sulfur components, major components, moisture, alkali metals, and seven trace elements. Monitoring of three operational test periods at the Hanna UCG test site has provided gas compositional data which indicate that: gas clean-up will likely be required to meet environmental standards for utility boiler SO_2 emissions if those emissions are not reduced by flue gas desulfurization; Gas clean-up will definitely be required to meet gas turbine feed gas specifications for fine particulates, alkali metals and sulfur; gas treatment including a wet quench to reduce gas temperature to 100°F will produce a wastewater stream requiring oil/tar separation at a minimum and may require trace element, sulfur and ammonia removal prior to discharge.

29800 (CONF-800716—, pp V.20-V.32) **Some environmental effects of the Pricetown I underground coal gasification test in West Virginia, USA.** Werner, E. (West Virginia Univ., Morgantown); Rauch, H.W.; Eli, R.N.; Gillmore, D.W. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Pittsburgh coal was gasified about 900 feet below land surface between vertical boreholes during June to October 1979. Water was monitored periodically at and near the site in streams, shallow wells and deep wells before, during and after the test. Ambient air was monitored continuously over the same period. Between 12 September and 19 October, chemical changes occurred in the ground waters during high-pressure air injection, as a result of a casing rupture in a production/injection well 205 feet below ground level. The effectiveness of the water monitoring program in detecting the contamination excursion and in following the deep migration of pollutants is discussed.

29801 (CONF-800716—, pp V.46-V.49) **Study of phenol adsorption by coal and minerals at a proposed UCC site.** Walters, E.A.; Niemczyk, T.M.; Merrell, G.A.; Erspamer, J.P.; Silver, M.S.; Hornung, S.D.; Nuttall, H.E. (Univ. of New Mexico, Albuquerque). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Phenols are expected to be one of the most significant organic groundwater contaminants resulting from a UCC burn, so it is important to know the ability of phenol to migrate through a coal seam with groundwater. Reported here are the results of adsorption studies of phenol on a clay (Na-Montmorillonite), raw coal, and clean coal. In each case adsorption follows a Langmuir isotherm; the adsorption capacity of the clay is 3.52 mg g^{-1} while two different slopes, indicating two different kinds of sites, were observed for clean coal. For one of these an adsorption capacity of 8.3 mg g^{-1} was observed while it was 108 mg g^{-1} for the other. Diazomethane was used to methylate hydroxyl groups of clay and coal; this leads to a reduction in adsorption capacity for both clay and coal, but the effect is much more pronounced for clay than for coal. It can be concluded that phenol will be adsorbed from aqueous solution rather effectively by coal and that at the very high phenol concentrations found in groundwater in the vicinity of test burns multilayer adsorption occurs in such a manner as to further reduce the mobility of phenol.

29802 (CONF-800716—, pp V.50-V.56) **Effect of lignite ash composition on ground water leachate.** Humenick, M.J. (Univ. of Texas, Austin); Lang, M. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Ground water leaching of inorganic species from Texas lignite ash was performed to determine the magnitude of their potential impact on groundwater. The study included identification and quantification of major contaminants. Leaching experiments using groundwater were performed on several lignites at mean and high temperatures. Results were compared to limited field data from past lignite gasification projects. Mineral species in the ash were identified by x-ray diffraction and these results will be used for subsequent work on the prediction of solubility equilibria.

29803 (CONF-800716—, pp V.57-V.70) **Restoration of in-situ coal gasification sites from natural groundwater flow and dispersion.** Way, S.C.; McKee, C.R. (Univ. of Wyoming, Laramie). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

This article is concerned with investigating the role of a fracture system and groundwater flow in dispersing contaminants from in-situ coal gasification sites. It was found that the dispersivities must be calculated with a knowledge of the natural groundwater flow to obtain the correct values. In practice the magnitude and direction of groundwater flow are fixed by geologic conditions. However it demonstrates that field experiments to obtain the dispersivities must be conducted in such a manner as to largely duplicate the direction of naturally occurring groundwater flow to obtain correct values. Examples are given to illustrate the dependence of the dispersivities upon the direction of groundwater flow. A site specific case is calculated from core data and estimated fracture spacing from an outcrop for the Hanna site. Here we obtain a value of 20 meters for the longitudinal and 0.60 meters for the transverse dispersivity. The principal axis for the coordinate system trends in a northeast direction coinciding with the dip of the formation. Dispersivities from other field examples were presented. The transverse dispersivity was varied to examine its effect on concentration reduction and calculation presented. It was concluded that dispersion alone can reduce the concentration by one to two orders of magnitude at distances which are equal to ten times the characteristic dimension of the gasified zone. It is anticipated that sorption effects in future studies will yield even larger reductions.

29804 (CONF-800716—, pp V.71-V.80) **Implications for in-situ coal gasification of developing federal regulatory programs.** Lacy, J.C. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Underground coal gasification comes under the separate regulatory authority of several different federal regulatory programs. The Permanent Regulatory Program of the Office of Surface Mining, under the Surface Mining Control and Reclamation Act, imposes one set of constraints. The status of UCG under EPA's regulatory programs for underground injection control and hazardous waste management has been significantly changed with the recent promulgation of new final regulations on May 19. This paper reviews the jurisdiction of these programs, and what the new regulations mean for UCG. Several issues raised by the current regulatory picture are also discussed.

29805 (CONF-800716—, pp V.81-V.90) **Interaction of contaminated water and solid material by-products from in situ coal gasification: implications for pollution control technology.** Manahan, S.E. (Univ. of Missouri, Columbia); Bornhop, D.; Farrier, D.S.; Sheesley, D.C.; Poulson, R.E. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Water infiltrating the cavity left from underground gasification of coal may dissolve a number of contaminants. This water may be purified, either by natural processes occurring underground, or by surface treatment after the water is pumped from the cavity. Any water treatment technologies utilized must have the advantages of low cost and ready availability of materials. In that respect

the coal, itself, and coal-derived products have major potential for the control of organic and inorganic water contaminants. This paper discusses some experimental and theoretical aspects of the uses of coal-derived solids for the purification of in situ coal gasification by-product water.

29806 (CONF-800716—, pp V.91-V.100) **Regulation of the hydrologic impacts of underground coal gasification.** Lacy, J.C.; French, L.N.; Grimshaw, T.W. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Regulation of the hydrologic impacts of underground coal gasification (UCG) stems from four basic pieces of federal legislation: the Clean Water Act, the Resource Conservation and Recovery Act, the Safe Drinking Water Act, and the Surface Mining Control and Reclamation Act. State regulatory authority varies in organization and does not always parallel federal authority. Federal regulations are usually more specific and stringent than state regulations, although some states have applied stringent regulations to particular areas or resources. Regulations dealing with hydrologic impacts of underground coal gasification may require both specific data and monitoring procedures and general standards of performance that demonstrate compliance with the regulations. Recognition of these hydrologic demonstrations is important because they may involve the collection of additional data, calculations, or modeling beyond the requirements that are specified in federal and state regulations. Hydrologic demonstrations may involve the prediction of post-reaction ground-water quality and flow patterns, mitigation of ground-water pollution and restoration of ground water to pre-reaction conditions, control or containment of pollutants after abandonment of UCG operations, and prediction and control of subsidence.

29807 (CONF-800716—, pp VI.20-VI.23) **Economic comparison of UCG with surface coal gasification processes.** Moll, A.J. (Synthetic Fuels Associates, Palo Alto, CA). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

The required price of clean MBG made by underground coal gasification is estimated at $5/MM Btu compared with $6/MM Btu for MBG made by Lurgi gasification. This price difference, although approximate, is believed to be real if reliable UCG operations can be achieved. The overall UCG process efficiency appears to be the most critical factor to the favorable economics. Process inefficiencies caused by underground gas leakage and by gas compression fuel requirements are the most adverse to UCG economics.

29808 (CONF-800716—, pp VII.1-VII.8) **Rawlins 1 product gas analytical instrumentation.** Miranda, J.E. (Gulf Research and Development Co., Pittsburgh, PA). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

In 1979, Gulf Research and Development Company and its subcontractor, TRW, Inc., completed the DOE-sponsored field test of underground gasification of steeply dipping coal beds at a site near Rawlins, WY. An analytical instrumentation system monitored gasification products. The analytical system was designed to provide redundant determination of specific data. This facilitated verification of data and provided backup analyses in the event of instrument malfunction. A detailed description of the analytical instrumentation will be discussed in terms of the comparison of data and the coordination with the data acquisition system.

29809 (CONF-800716—, pp VII.9-VII.15) **Buried telemetry system for temperature measurements.** Caffey, T.W.H.; Barnes, D.E. (Sandia National Labs., Albuquerque, NM). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

A telemetry system which measures temperatures within a buried energy extraction process from beneath the process bed is described. The temperature data are laterally transmitted through the earth to a receiver outside of the high temperature zone and then sent to the surface by wire. The system has a range of 46 meters, a bit error probability of less than 10^{-7}, battery capacity for six months operation, and can measure 13 external temperatures each hour.

29810 (CONF-800716—, pp VIII.6-VIII.13) **Technical analysis of the Hanna III Field Test data.** Gunn, R.D. (Univ. of Wyoming, Laramie); Bell, G.J.; Bartke, T.C.; Camp, D.W.; Krantz, W.B. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

A technical analysis is made of both the reverse combustion and forward gasification phases of the Hanna III UCG Field Test. Stability theory and a linear combustion model are combined to determine the characteristics of the reverse combustion linkage channel. Material balance calculations substantiate the accuracy of these predictions. These data have important implications concerning the operation of a field test. A forward combustion model is used to calculate the amount and heating value of the gas produced with good accuracy. A necessary input parameter to the model is the rate of water influx. To determine this quantity for earlier field tests, a material balance based on field test results was used. For Hanna III, however, a recently developed water influx model has been used instead. Thus, the combined theories are fully predictive with no field test data used in the calculations. Water injection, which was necessary because of very high well head temperatures, greatly complicates the technical analysis.

29811 (CONF-800716—, pp VIII.14-VIII.23) **Mass balances for underground coal gasification in steeply dipping beds.** Lindemand, R. (TRW Energy Systems, Lakewood, CO); Ahner, P.; Davis, B.E. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Two different mass balances were used during the recent Underground Coal Gasification tests conducted in steeply dipping coal beds at Rawlins, Wyoming. The combination of both mass balances proved extremely useful in interpreting the test results. One mass balance which assumed char could be formed underground required the solution of three simultaneous equations. The assumption of no char decouples the three equations in the other mass balance. Both mass balance results are compared to the test data to provide an interpretation of the underground processes. Several conclusions can be drawn from this analysis: (1) the operating efficiencies and energy ratios for the Rawlins SDB test are comparable to the data for some of the tests in horizontal seams; (2) direct injection of water with the air is not an effective means of controlling the water to coal ratio at the flame front over a 30 day test; (3) MB-1 which assumed no char proved to be the more reasonable of the two mass balances. A detailed error analysis of both mass balances based on the Rawlins data is currently being prepared; (4) the char term from MB-2 may prove to be an effective indicator of pyrolysis activity in the reactor. As such it may be useful in process control of a UCG operation; (5) from test day 26 till the end of the test, the air blast did not sweep out the total reactor volume as shown by the helium tracer gas data; and (6) approximately 12 to 24% of the sulfur in the coal appeared as H_2S in the product gas.

29812 (CONF-800716—, pp VIII.24-VIII.31) **Site qualification study of the UCG site at North Knobs.** Ahner, P.F.; Avasthi, J.M.; Davis, B.E.; Dolde, M.E.; Greenman, C.A.; Miranda, J.E. (Gulf Research and Development Co., Pittsburgh, PA). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

The GR and DC field test of the UCG/SDB process was performed at the North Knobs area west of Rawlins, WY. The test was performed in the fall of 1979. Previous to the test a comprehensive geotechnical program was required to obtain information essential for a successful test. The data obtained were necessary for design of the test, design of the surface facility, permitting, process module placement and environmental studies.

29813 (CONF-800716—, pp VIII.65-VIII.73) **Licensing of the Hoe Creek III experiment: what is groundwater restoration.** Sullivan, D.A.; Atwood, K.L.; Ivory, T.M.; Morgan, P.V. (NUS Corp., Denver, CO). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

As the first application reviewed under the Wyoming In Situ Mining Act of 1979, the environmental licensing of the Hoe Creek III experiment provides insight into current regulatory constraints in Wyoming. Of all of the environmental issues associated with the licensing of this experiment, groundwater restoration remains as the most sensitive issue for future experiments and commercial development. Through judicious site selection and thorough evaluation of the Best Practicable Technology for groundwater restoration, it is expected that the current regulatory framework in Wyoming can allow for development of the in situ coal gasification industry within the state if the regulations are implemented within the form and intent of the Wyoming In Situ Mining Act. The acceptability of groundwater restoration by passive sorption, without the need for supplementary restoration techniques, will be an important factor to future development. An essential goal of front-end planning to meet regulatory constraints will be minimizing the need for supplemental restoration.

29814 (CONF-800716—, pp VIII.74-VIII.78) **Subsidence as a technical hazard to underground coal gasification.** Salotti, C.A.; Avasthi, J.M. (Gulf Research and Development Co., Pittsburgh, PA). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Subsidence effects initiated by an underground coal gasification (UCG) operation result not only from the removal of material, but also in response to the burn's positive pressure, elevated temperature, and chemically active gas. An evaluation of the risks associated with UCG-induced subsidence can be discerned by systematic analysis, and presently most of the information and its processing needed to quantify UCG-related subsidence can be defined. This evaluation suggests that an increased emphasis should be directed toward detailed geotechnical site appraisal to minimize subsidence risk.

29815 (CONF-800716—, pp VIII.79-VIII.89) **UCG link zone and cavity development at Pricetown I.** Eddy, T.L.; Ford, W.H. Jr.; Thynell, S. (West Virginia Univ., Morgantown). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

The methods used to determine the detailed link zone geometry at Pricetown I using experimental staged flows, pressure drops, product gas composition, and monitor well thermocouple measurements are described. The resulting combustion link enhancement (CLE) model fills the gap between existing reverse combustion linking (RCL) and forward gasification (FG) models. The link zone shape resembles an unbalanced dumbell. The cavity shape during gasification is developed using four varieties of the WVU cavity model, including the simple energy balance with convection and optically thin or thick radiation heat transfer. Cavity predictions are compared with cavity locations indicated by experimental thermocouple data and measured product gas compositions. The Pricetown I field test indicates that three distinctive types of burns exist: reverse combustion linking (RCL), combustion link enhancement (CLE) and foward gasification (FG). In addition to the conclusions regarding the field test data, we find that the computer model for CLE is simpler than the FG model, though they are of nearly identical form. The calculation described here is based on the simple chemical energy balance, WVU Model IIA, in order to obtain a more realistic determination of the link zone geometry prior to gasification within the time and financial constraints available.

29816 (CONF-800716—, pp VIII.104-VIII.113) **Selection of a gas treatment process for UCG gases.** Siegel, M.M.; Rogers, T.F.; Mason, R.Z. (Williams Brothers Engineering Co., Tulsa, OK). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

A review of the obstacles, opportunities and alternatives which must be faced in choosing a gas treatment process for UCG gases is presented. Low BTU gases will be used primarily for on-site process heat, steam raising and/or electric power generation. Medium and high BTU gas will be produced for transport by pipeline. The gas treatment processes available need to be reviewed relative to the requirements of the different gas BTU levels. The presence or absence of oxygen greatly effects the choice of gas treatment processes. A large scale multi-well test will be required to determine the magnitude of the problem.

29817 (CONF-800716—, pp VIII.114-VIII.139) **Hydrologic site characterization for in-situ coal gasification.** McKee, C.R. (Univ. of Wyoming, Laramie); Way, S.C.; Gunn, R.; Evers, J. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Recent experience at Hoe Creek and Hanna underscores the importance of the hydrological properties of the coal seam and adjacent confining layers to the gasification process. Permeability of the confining layers governs water influx and therefore gas quality. Directional permeability and the ratio of horizontal to vertical permeability and vertical stratification will control linking and the orderly progress of forward gasification. Practical hydrologic testing methods are outlined for obtaining directional permeability, the ratio of horizontal to vertical permeability, permeability of confining layers, along with compressibility, well efficiency and the in-situ fracture distribution. Vertical stratification is obtained using a new downhole flow tool sensitive to flow rates as small as 0.1 gpm. Field examples are given to illustrate the required instrumentation and derived parameters. Using the measured directional permeability, wells can be spaced and oriented properly for air acceptance and pilot testing. The well pattern we suggest using is no more costly, and in some instances less costly, than others used in previous hydrologic evaluation of sites for in-situ coal gasification. The analytical techniques are more tedious to apply. However they are more complete in the sense that more parameters are accounted for simultaneously, thereby increasing the accuracy of the analysis.

29818 **(DOE/ET/10154—T13) Operation of the solvent-refined-coal pilot plant, Wilsonville, Alabama. Monthly technical progress report, June 1981.** (Southern Co. Services, Inc., Birmingham, AL (USA); Catalytic, Inc., Wilsonville, AL (USA)). Aug 1981. Contract AC22-76ET10154. 36p. (FE—10154-84). NTIS, PC A03/MF A01. Order Number DE81028943.

This report summarizes the operating conditions and test results during June 1981 at the six ton per day solvent refined coal (SRC-I) pilot plant in Wilsonville, Alabama. The plant operated from 1 to 21 June, processing Kentucky 9 coal from the Fies mine. The pilot plant was shut down for maintenance and repairs from 21 to 30 June. Run 228, that was started on 18 May, was completed on 1 June. It was made to compare performance data when the operating temperature was 825°F (Run 228) vs 840°F (Run 227). Run 229 started on 1 June and was completed on 21 June. For this run, B102 inlet pressure was increased from 2100 to 2300 psig. All other conditions duplicated Run 228 operating conditions. The hydrotreater operated intermittently from 1 to 16 June. Progress was made in improving the accuracy of instrumentation readings, in understanding the impact of equipment operation on the process and products, and in developing material balance techniques.

29819 **(DOE/ET/10204—T1) Low-Btu gasification of coal for electric power generation. Phases I, II and III. Monthly progress report, April 1-April 30, 1981.** (Combustion Engineering, Inc., Windsor, CT (USA)). 16 Aug 1981. Contract AC01-76ET10204. 46p. (FE—1545-89). NTIS, PC A03/MF A01. Order Number DE81029482.

Oxygen-enriched operation of the PDU was initiated on April 1, 1981. Eleven oxygen enriched gasmaking tests were made during the month. These tests were interrupted upon eight occasions by slag tap pluggage or imminent pluggage. Direction was received from both contract sponsoring agencies (DOE and EPRI) changing the priority of April's testing from shakedown and parametric oxygen-enriched testing to running a 15 to 20 day sustained operations test. This test was begun during the month, but not suc-

cessfully completed owing to the tap hole pluggage problems. Iron reduced from the slag due to the low oxygen concentration in this region is the most obvious explanation for the tap hole pluggages.

29820 (DOE/ET/10325—T6) Cryogenic methane separation/catalytic hydrogasification process analysis. Quarterly report. Klosek, J. (Air Products and Chemicals, Inc., Allentown, PA (USA)). 13 Feb 1981. Contract AC01-78ET10325. 9p. NTIS, PC A02/MF A01.

The objective of this coordinated research program is to obtain the most attractive combinations of acid gas removal, methane separation for the Exxon Catalytic Coal Gasification (CCG) and the Rockwell/Cities Service Hydrogasification processes. The program is divided into nine subtasks with each subtask studying the effect of variation of a key design parameter on the treatment cost of the SNG produced. Progress reports of 8 subtasks are presented. The following are some of the highlights. Subtask 1 - Heat and material balance and equipment sizing was completed for the cryogenic methane separation. The overall material balance is presented in a table. Subtask 2 - Preliminary designs for MEA and DEA gas removal systems were established. Subtasks 3 to 5 - Economic evaluation is in proress. Subtask 6 - The SNG product compressor train was simulated for the case where sufficient SNG fuel is withdrawn from the product compressors to fire the dryer reactivation heater. Subtask 7 - Acid gas removal and cryogenic separation equipment was resized to accommodate Exxon's request for a two-train plant design. Subtask 8 - The Benfield and Selexol systems will be evaluated for acid gas removal.

29821 (DOE/ET/10325—T8) Cryogenic methane separation/catalytic hydrogasification process analysis. Quarterly report. Klosek, J. (Air Products and Chemicals, Inc., Allentown, PA (USA)). May 1981. Contract AC01-78ET10325. 39p. NTIS, PC A03/MF A01.

The objective of this coordinated research program is optimization of the Rockwell/Cities Service Short Residence Time Hydrogasification (SRTH) and the Exxon Catalytic Coal Gasification (CCG) processes in the acid gas removal and cryogenic areas. Progress reports of eight subtasks are presented along with process flowsheets, heat and material balances and economic evaluation, summarized in tables. Each subtask studied the effect of variation of a key design parameter on the treatment cost of the SNG produced.

29822 (DOE/ET/10445—1) Separation of particles from coal derived liquids via surface charge properties. Final report, August 1977-May 1981. Gidaspow, D.; Wasan, D. (Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering). Jul 1981. Contract AS02-77ET10445. 97p. NTIS, PC A05/MF A01. Order Number DE81029088.

An improved method of removal of fine particles suspended in nonaqueous media by the application of a high-voltage (1000 to 10,000 V/cm) electric field was developed. The technique is a modification of ordinary cross-flow filtration with a porous tube and of forced flow electrophoresis. The electrofilter was tested with a synthetic nonaqueous slurry as well as samples of diluted H-coal process liquids obtained from a coal liquefaction pilot plant at various electric field strengths, driving pressures, and feed rates. Models of clear boundary layers for flat and tubular cross-flow electrofilters were developed as a function of inlet Peclet number, electrophoretic velocity of particles, and rate of filtration. A description of the flow field in the cross-flow electrofilter was obtained by solving a laminar annulus flow with suction through an outer porous wall. A perturbation solution for the flow field was then used in a mathematical model which describes the concentration field of the electrofilter. Numerical solutions were obtained by using the Crank-Nicholson finite difference method. Clear boundary layer near the filter wall can be calculated by either the finite difference method or the method of characteristics. A separate material balance gives a reasonable deposition cake thickness on the central electrode and the outlet concentration of the filter unit.

29823 (DOE/ET/10518—T3) Catalytic coal liquefaction. Quarterly report, January-March 1981. Weller, S.W. (Southern California Edison Co., Camp Pendleton (USA)). 1981. Contract AC22-76ET10518. 16p. NTIS, PC A02/MF A01.

A new tubing bomb micro reactor has been designed, constructed, and tested. It is suitable for catalyst comparisons in experiments of widely differing nature. The reactor is capable of initial pressurization with H_2, heating, pressure monitoring during a run, and G.C. analysis of gaseous products. An extensive series of runs has been completed on the hydrotreating of 1-methylnaphthalene as a multifunctional catalyst screening test at 500°C. Six Co/Mo/Al_2O_3 catalysts from four suppliers have been tested (after presulfiding), along with a comparison run with stannous chloride. At a catalyst level of 0.5 wt.%, the rank-ordering of activity for ring hydrogenation (RHG) was Cyanamid HDS-1442B > AmocatlA > Harshaw 0402T ~ AkzoPA-23924 > Amocat1B > Akzo77-RAM-3. Ring hydrocracking (RHC) activity decreased in the order Amocat 1A ~ Amocat1B > Akzo PA-23924 > Harshaw 0402T > Akzo 77-RAM-3 ~ Cyanamid HDS1442B. Hydrodemethylation (HDM) is almost unaffected by Co/Mo/Al_2O_3 catalysts. At 500°C the extent of RHC and HDM is much greater than at 450°C, but the extent of RHG is much less.

29824 (DOE/ET/10735—T1) Two-stage coal-liquefaction process. Quarterly report, October 1-December 31, 1979. Kang, C.C. (Catalysis Research Corp., Palisades Park, NJ (USA)). 15 Jan 1980. Contract AC22-78ET10735. 16p. NTIS, PC A02/MF A01.

Catalyst No. CT-4247 was selected and sent to Amoco for evaluation in the continuous unit. The autoclave unit was modified as follows: (1) In order to obtain a consistent amount of autoclave product from different runs, the liquid sampling tube with the 230-micron filter was modified by ending the sampling tube vertically and turning the filter to a vertical position. This modification provides sufficient rigidity to the end of the tube and prevents it from changing position. (2) A hydrogen reservoir was added to the unit. It was equipped with a high pressure regulator to admit the hydrogen needed to maintain a constant pressure of 2500 psig in the autoclave. Runs carried out under a constant pressure of 2500 psig confirm that (1) macropore catalysts with median pore diameter of 2350 and 4000 Angstrom were capable of higher coal conversion than HDS-1442A, and (2) large macropore catalysts with median pore diameters of 18,500 and 32,000 Angstrom had same coal conversion as HDS-1442A but at much lower hydrogen consumption than HDS-1442A. However, HDS-1442A and Amocat 1A (II-108/16) with bimodal pore size distribution and high surface area yielded 10% (basis coal feed) less toluene-insoluble residuum and correspondingly more toluene-soluble residuum than the macropore catalyst with low surface area.

29825 (DOE/ET/13060—T9Vol.1) Phase I. Pipeline gas demonstration plant. Volume I. Schedules, controls, and staffing. Ditter, D.J. Jr. (Conoco, Inc., Stamford, CT (USA)). 1981. Contract AC01-77ET13060. 305p. (FE—2542-40Vol.1). NTIS, PC A14/MF A01. Order Number DE81028429.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I), scheduled to be completed in June, 1981. Task VII in Phase I requires a staffing plan, a configuration management plan, and construction schedules and controls. Staffing plans for Conoco Inc. and a typical construction managing firm are presented. Peak supervisory manpower will be approximately 100 from the nineteenth through the twenty-sixth month of construction. The Configuration Management Plan for Phase II is outlined. The bulk of this volume contains details on Phase II controls and schedules. The major conclusions of this preliminary construction schedule are: (1) plant start-up will occur 39 months after Phase II begins; (2) Section 100 (Feedstock Preparation) engineering and purchasing are critical activities at the start of Phase II; (3) Section 2000 (Steam Plant) construction is critical to construction completion; (4) the low float time on Section 100 (Feedstock Preparation) and Section 300 (Gasification) Construction activities means these sections must be monitored very closely; (5) total manpower requirement is 3.644 million man-hours with a peak of 1400-1500 men on site.

29826 (DOE/ET/13060—T10) Pipeline-Gas Demonstration Plant. Phase I. Procurement plan for coal feedstocks. Leaman, G.J. Jr. (Conoco, Inc., Stamford, CT (USA)). 1980. Contract AC01-77ET13060. 93p. (FE—2542-39). NTIS, PC A05/MF A01. Order Number DE81028445.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the United States Department of Energy (DOE) provides for the design, construction, and operation of a Demonstration Plant capable of converting high sulfur, bituminous caking coal to clean pipeline quality gas. One of the assignments under the contract is to find potential suppliers of coal and coke feedstocks for operation of the plant during Phase III of the project. Competitive supplies of Pittsburgh No. 8 coal, Ohio No. 9 coal, petroleum coke and anthracite coal can be obtained for the Demonstration Plant. Requests for Proposals to supply the materials will be issued to identified suppliers during construction of the plant. Specifications for the materials have been set by the design of the Demonstration Plant and pilot plant experience.

29827 (DOE/ET/13153—T3) Short-residence-time hydropyrolysis of coal. Technical progress report, 1 April 1980-30 June 1980. Saville, D.A.; Russel, W.B. (Princeton Univ., NJ (USA). Dept. of Chemical Engineering). 1980. Contract AC01-79ET13153. 16p. NTIS, PC A02/MF A01.

A fundamental study of the hydropyrolysis of small coal particles at high pressures and short residence times of both solid and gas is underway to elucidate the chemical and physical rate processes governing delineated conditions favorable toward high yields of gas and light aromatic liquids. Our aim is to develop an understanding of short-contract-time hydropyrolysis based on studies which carefully isolate events occurring within single particles from effects due to gas phase reactions or slow quenching of the solid. A novel laboratory reactor has been fabricated which will provide short residence times with rapid heating. Detailed chemical and physical analyses of both the parent coal and the product distribution will be obtained as a function of extent of reaction and the process conditions. This data will then be analyzed in terms of a model for the coupling between the heat and mass transfer and chemical reactions within an individual particle. During the past quarter the reactor system was readied for kinetic studies of weight loss with PSOC 102, Pittsburgh seam HVA bituminous.

29828 (DOE/ET/13384—T2) Solid circulation around a jet in a fluidized-bed gasifier. Final report. Caram, H.S.; Patrose, B. (Lehigh Univ., Bethlehem, PA (USA)). Apr 1981. Contract FG01-78ET13384. 45p. NTIS, PC A03/MF A01.

The main purpose of the study was the analysis of particle circulation in the jet region of a fluidized bed gasifier. The two fundamental questions answered by this report relate to the measurement of particle velocities in the grid region and to the relevance of the jet zone to the operation of the reactor. Particle velocities were measured at corresponding points within a jet in the two-dimensional bed, using the optical fiber probe and a Laser Doppler Velocimeter (LDV). The probe measurements compare well with the LDV results in the main jet region. Particle velocities were also measured with the probe in the dense phase region of the fluidized bed where measurements were not possible using LDV. The resulting flow maps clearly indicate solids circulation patterns around jets and identify dead zones formed on the distributor plate. The entering gas jet was modeled assuming that the dense phase is entrained into the gas stream. The solid particles are then conveyed upwards along the jet penetration distance. Typical conditions for a fluidized bed combustor were used and the model includes the reactions between carbon and carbon dioxide and oxygen and the homogeneous oxidation of carbon monoxide. The results indicate that considerable reaction occurs in the gas jets entering the reactor and that they should be considered in any careful analysis of its operation.

29829 (DOE/ET/14876—T4) Catalysts for upgrading coal-derived liquids. Quarterly report, April 1-June 30, 1981. Crynes, B.L. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 16 Jul 1981. Contract AC22-79ET14876. 21p. NTIS, PC A02/MF A01. Order Number DE81028332.

Five catalysts were analyzed for pore size distributions to characterize their properties for selection for future experimentation. Also, several coal liquid feedstocks were obtained and were analyzed in preparation for future studies. Four experimental runs were conducted in the Catalyst Life Test Unit using a 30 wt % SRC in process solvent mixture. These runs were conducted using a Shell 324 catalyst ($NiO-MoO_3$) at a temperature of 399°C (750°F) and a pressure of 13.9 MPa (2000 psig). The purpose of these runs was to obtain conditioned catalysts in order to assess the coking and deactivation response. Hydrodenitrogenation and hydrogenation of the catalysts decayed over the interval of study of these four experimental runs. Experimentation time was from 1 up to 160 hours of oil-catalyst contact. These conditioned catalysts have not yet been analyzed. A controlled experiment is being designed to test the catalyst activity decay caused by organometallics in coal liquids. The experimentation is being prepared to test a 400 ppM of titanocene doctored SRC light oil. This experiment will be conducted in the early part of the following quarter.

29830 (DOE/ET/14881—6) Mechanisms and kinetics of coal hydrogenation. Quarterly progress report, April-June. Baldwin, R.M.; Furlong, M.W. (Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering). Jul 1981. Contract AC22-79ET14881. 51p. NTIS, PC A04/MF A01. Order Number DE81028210.

Colorado School of Mines is engaged in an experimental program for the Department of Energy to develop comprehensive models for the effects of coal composition upon the kinetics and mechanisms of coal hydrogenation, for the effects of mineral matter additives (disposable catalysts) upon kinetics and mechanisms of coal hydrogenation, and for the kinetics and mechanisms of the hydrogenation of coal derived products such as preasphaltenes and asphaltenes. The continuous flow coal processing unit was modified to alleviate problems with non-representative sampling during the course of operation. A synthetic recycle oil solvent was prepared to allay any doubts regarding the distribution of reacted solvent components in the product samples. Data from the coal reactivity study was fitted by true second-order reversible kinetics expressions. The forward rate constants were correlated with H/C ratio, mean-max reflectance, and fraction reactive macerals of the parent coals. Kinetic reactivities were also shown to correlate with the percentage of volatile carbon in the parent coals. Intrinsic THF solubilities of the parent coals were measured experimentally and the resulting values incorporated in the evaluation of second-order rate constants. The reactivities were not significantly affected by this modification. Reproductibility tests were initiated in the disposable catalysts study. Agreement between these data and those from the initial phase of this study were fair. Further tests will be made to verify these results.

29831 (DOE/FE/20216—1) Low/medium Btu coal gasification assessment program for potential users in New Jersey: executive summary. (Burns and Roe Industrial Services Corp., Paramus, NJ (USA)). May 1981. Contract AC01-79RA20216. 21p. NTIS, PC A02/MF A01. Order Number DE81025475.

This preliminary study evaluation has manifested an overall technical and economic feasibility for producing a medium Btu quality gas (MBG) from coal at PSE and G's Sewaren Generating Station in New Jersey. The production of MBG for use as a fuel gas for on-site power plant boilers or for distribution to industrial customers appears to be economically attractive. The economic attractiveness of MBG is very dependent on the location of sufficient numbers of industrial customers near the gasification facilities and on high utilization of the gasification plant. The Sewaren Generating Station was identified as potentially the most suitable site for a gasification plant. The Texaco Coal Gasification Process (TCGP) was selected as the gasifier type due to a combination of efficiency and pilot plant experience. Further, it has the advantage of being a pressurized process, capable of supplying the gas without downstream compression which is required if the gas is to be transported to industrial consumers. The TCGP can handle the high sulfur eastern coals chosen as a feedstock. All equipment downstream of the gasifier is commercially proven. For maximum efficiency and flexibility, it would be desirable to consider the integration of the gasification process with a methanol synthesis plant, consuming up to 25% of the MBG produced. Such a combination scheme would allow storage of MBG when its demand is low and thereby increas-

ing the gasifier capacity factor and minimizing its turndown requirements.

29832 **(DOE/FE/20216—2) Low/medium-Btu coal-gasification-assessment program for potential users in New Jersey. Final report.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA)). May 1981. Contract AC01-79RA20216. 152p. NTIS, PC A08/MF A01. Order Number DE81028553.

Burns and Roe Industrial Services Corporation and Public Service Electric and Gas in association with Scientific Design Company have completed a technical and economic evaluation of coal gasification. The evaluation also addressed the regulatory, institutional, and environmental issues of coal gasification. Two uses of coal-derived medium Btu (MBU) gas were explored: (1) substitute boiler fuel for electric generation and (2) substitute fuel for industrial customers using natural gas. The summary and conclusions of his evaluation are: The Sewaren Generating Station was selected as potentially the most suitable site for the coal gasification plant. The Texaco process was selected because it offered the best combination of efficiency and pilot plant experience; in addition, it is a pressurized process which is advantageous if gas is to be supplied to industrial customers via a pipeline. Several large industrial gas customers within the vicinities of Sewaren and Hudson Generating Stations indicated that MBG would be considered as an alternate fuel provided that its use was economically justified. The capital cost estimates for a 2000 tons/day and a 1000 tons/day gasification plant installed at Sewaren Generating Station are $115.6 million and $73.8 million, in 1980 dollars, respectively. The cost of supplying MBG to industrial customers is competitive with existing pipeline natural gas on a Btu heating value basis for gasifier capacity factors of 35% or higher.

29833 **(DOE/MC—170) Summary test report: Walworth, Bolted-Bonnet, Solid-Wedge Gate Valve METC SOA Test Valve No. A-20 state-of-the-art Lockhopper Valve-testing and Development Project.** Gardner, J.F.; Gayheart, T.R.; Griffith, R.A.; Hall, R.C.; Hornbeck, R.G.; McGhee, T.A.; Maxfield, D.A.; Nutter, T.M.; Nieman, H.D. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). May 1981. Contract AM21-80MC14522. 40p. NTIS, PC A03/MF A01. Order Number DE81025182.

The Walworth, Bolted-Bonnet, Solid-Wedge Gate Valve (METC SOA Test Valve No. A-20) performed well in testing with clean gases. In testing with limestone solids, the bonnet and body cavities tended to pack tight with solids. Also, solids were being caught between the gate and seats when the valve closed. Modifications to the purge system virtually eliminated accumulations of solids in the bonnet and reduced the frequency of solids being caught between the gate and seats. After a total of over 6000 test-valve cycles, the valve jammed as a result of particles trapped between the gate and seats. Freeing the gate required heating the valve body and applying over 100 times the normal operating force.

29834 (DOE/MC/08333—167, pp 245-274) **Characterization of high temperature vapors of import to combustion and gasification processes in the energy technologies.** Gole, J.L. (Georgia Inst. of Tech., Atlanta). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

Research efforts are outlined whose focus is the characterization of compounds of import to the energy technologies. The reactions of potassium and sodium with hydrogen peroxide have been used to excite chemiluminescence from KOH and NaOH. The study of this chemiluminescence over a wide variety of experimental conditions leads to the direct determination of stringent lower bounds for the K-OH and Na-OH bond energies. For KOH, we find D: $\geq$ 85.2 kcal/mole; for NaOH, D: $\geq$ 75.2 kcal/mole. The present results lead to an estimated K-OH bond strength of 88 +- 2 Kcal/mole, notably higher than the currently accepted value. The characterization of Na_2O via laser spectroscopy is summarized and molecular constants for this molecule are presented. Preliminary studies of the bonding and spectra of the alkali monoxides are presented. Recent studies of ultrafast energy transfer in a variety of high temperature molecules are also outlined.

29835 (DOE/MC/08333—167, pp 667-680) **Sampling a high temperature-high pressure process stream with a cascade impactor.** Newton, G.J.; Carpenter, R.L.; Cheng, Y.S.; Barr, E.B.; Yeh, H.C. (Inhalation Toxicology Research Inst., Albuquerque, NM). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

Cascade impactor sampling of entrained ash from a high temperature-high pressure process stream of a low Btu coal gasifier is reported. The cascade impactor was designed with stages having an effective size cutoff ranging from 12 μm down to about 0.5 μm aerodynamic diameter. Methods for calculating the viscosity, density, and mean free path of the gas mixture have been developed and used to calculate impactor stage characteristics at operating temperatures and pressures for the gas mixture sampled. Process stream conditions were 400 to 700°C and 900 to 1370 kPa (9 to 13.6 atm) with typical gas constituents of: 30 to 60% N_2, 15 to 20% CO, 5 to 15% CO_2, 10 to 15% H_2, $<$ 5% CH_4, and $<$ 1% each of C_2H_6 and H_2S. The major size distribution at stream conditions indicated a mass median aerodynamic diameter (MMAD) of 2.81 +- 0.53 μm with a geometric standard deviation (σ g) of 2.48 +- 0.80 and a mass concentration of 5.0 x 10^{-2} g/m^3. Other methods using cooling and dilution indicated a smaller size distribution with 50 times the mass loading due to condensed tars and oils. Size classified samples were also suitable for chemical analyses to address cyclone cleanup efficiency, combustion efficiency, and presence of alkali compounds.

29836 **(DOE/MC/14600—T3) Coal feeder development. Quarterly technical progress report, April - June, 1981.** Mistry, D.K. (Ingersoll-Rand Research, Inc., Princeton, NJ (USA)). Jul 1981. Contract AC21-80MC14600. 25p. NTIS, PC A02/MF A01. Order Number DE81028636.

The pilot scale piston feeder development is progressing satisfactorily and should proceed as planned. The bench scale testing of components, sub-system and critical areas continued to provide very useful information. The K30M seals and poly-urethene scrapers compatibility for this application must be examined. The upgrading of the pilot scale feeder and its test system progressed satisfactorily during this quarter. The fabrication, procurement, installation and shakedown of the new 9" bench scale tester is essentially completed. The coal flow capability and limitation testing with this tester will be completed during the next quarter. No progress on the 5.5" diameter pilot scale screw feeder has been made because IRRI is waiting decision from METC as to when the feeder can be installed on the 42" gas producer.

29837 **(DOE/MC/14601—T4) Coal materials handling: coal-feeder development, phase I. Third quarterly technical progress report, April-June 1981.** (Foster-Miller Associates, Inc., Waltham, MA (USA)). 4 Aug 1981. Contract AC21-80MC14601. 18p. NTIS, PC A02/MF A01. Order Number DE81028432.

The objective of Phase I of the program is to demonstrate extended operating capabilities of the Linear Pocket Feeder (LPF). This has required extensive modifications to both the test facility and the LPF in order to effectively conduct extensive testing with both coarse and pulverized coal (PC) at increased operating pressures. Initial tests with PC conducted in the last quarter were successful in that LPF operation with fine coal sizes was demonstrated. However, these tests also showed that the facility and LPF modifications required to conduct the test program were more extensive than originally planned, and that the direction of effort needed to be modified accordingly. Although it was originally projected that the necessary modifications could be initiated without affecting the performance testing phase of the program, this has not proven to be the case. Procurement delays and additional effort required for equipment development have necessitated a reduction in scope of Phase I testing. We currently project that facility and LPF operation at increased operating pressures for both coarse and fine coal sizes can be demonstrated in this phase of the contract, but extended performance testing will have to be delayed until Phase II. Current status may be summarized as follows. Design work and/or

specification of commercial equipment required for LPF and facility modification has been completed.Procurement is substantially complete, except for the coal stripping/gas recirculation system which is not necessary for startup. Installation of components is nearing completion, with system startup anticipated in early August. The flow visualization model has been assembled and is operational. Methods for measuring moisture have been developed.

29838 (DOE/OR/03054—2) **SRC-I. Quarterly technical report, October-December 1980.** (International Coal Refining Co., Allentown, PA (USA)). 1980. Contract AC05-78OR03054. 139p. NTIS, PC A07/MF A01. Order Number DE81028917.

Six articles have been entered individually into EDB and ERA. The articles relate to the SRC-I Demonstration plant as follows: desulfurization of synthesis gas, recovery of sulfur and liquefied petroleum gases, equipment for unloading coal from barges, evaluation of slurry pumps, pipes and heaters for the plant and characterization of plant waste water and monitoring the water treatment. (LTN)

29839 (DOE/OR/03054—2, pp 1-19) **Two-step desulfurization evaluation downstream of the GKT coal gasification process.** Wilkins, J.T. (International Coal Refining Co., Allentown, PA). 1980. NTIS, PC A07/MF A01.

In SRC-I. Quarterly technical report, October-December 1980.

The supplemental hydrogen needed for the SRC-I liquefaction process and hydrogen required for the expanded-bed hydrocracking process in the Demonstration Plant will be supplied by gasifying a mixture of Kerr-McGee ash concentrate, recovered from the SRC deashing step, and coal. Geselschaft fuer Kohle-Technologie (GKT) coal gasification will be used, producing a raw synthesis gas composed mainly of hydrogen (H_2) and carbon monoxide (CO). However, relatiely pure, sulfur-free H_2 at high pressure is necessary for both the liquefaction and EBH processes. Therefore, the raw synthesis gas will be processed in three additional steps: (1) pressurization; (2) shift conversion, to maximize hydrogen production; and (3) purification. This report compares two processing schemes encompassing these three steps.

29840 (DOE/OR/03054—2, pp 21-34) **Sulfur recovery area sensitivity studies: Base Case vs. Claus unit and Beavon sulfur removal unit.** 1980. NTIS, PC A07/MF A01.

In SRC-I. Quarterly technical report, October-December 1980.

Variations in the composition of coal used in the SRC-I Demonstration Plant will affect the operation and performance of the sulfur recovery area processing units. In addition, the need exists to more clearly define the penalty or value of process redundancy in the sulfur recovery area. A sensitivity study has been conducted by the R.M. Parsons Company, the gas system sulfur recovery area contractor. Gasification of Kerr-McGee ash concentrate to generate the required makeup hydrogen and associated downstream processing as defined in Phase 0 serve as the Base Case. This study is based on combined operation of the Claus unit and the Beavon sulfur removal unit (BSRU). In this report, variations (i.e., H_2S concentration and total volume) in the acid gas streams generated in the gas treating areas are related to capital cost factors for both the Claus unit and the BSRU. In addition, utility and catalyst and chemical makeup incremental changes are related to incremental changes in acid gas volumetric flow and hydrogen sulfide composition. In all cases studied, the incremental variation in acid gas volumetric flow results in a proportional incremental variation in the capital cost factor for both the Claus unit and the BSRU. Similar results are indicated for incremental variations in the acid gas hydrogen sulfide concentration. This study may serve as a basis for evaluating the economic and processing tradeoffs associated with designing the sulfur recovery area to handle expected variations in the acid gas streams. These variations may be due to coal feedstock composition changes, different generating modes for the SRC-I Demonstration Plant, or changes in the operating efficiencies of the upstream acid gas removal units.

29841 (DOE/OR/03054—2, pp 35-59) **Comparison of two methods for recovery of liquefied petroleum gas.** 1980. NTIS, PC A07/MF A01.

In SRC-I. Quarterly technical report, October-December 1980.

Two methods of recovering liquified petroleum gas (LPG) from the low-pressure fuel reject gas that exits the hydrogen purification unit (HPU) in the gas treating area of the Demonstration Plant were compared: (1) Expander Scheme: The reject stream is compressed, cooled by heat exchange, and then let down in pressure through the compander, to chill the gas and condense the LPG components. The chilled stream is sent to the de-ethanizer to recover and produce the LPG product. (2) Refrigerated Lean Oil Absorption Scheme: The reject stream is compressed and then passed through an absorber column to extract the LPG components by absorption with coal lean oil. Rich oil leaving the absorber is stripped of ethane in the de-ethanizer and then fed to the rich oil still, where LPG is distilled and recovered. A third recovery scheme, Low-Temperature Separation, was considered, but not developed in detail after preliminary calculations indicated excessively high capital and operating costs. Detailed plant designs for the Expander and Refrigerated Lean Oil Absorption Schemes were developed, so that construction and utility costs could be estimated and overall cost differences (delta costs) derived. Because the total annual construction and total annual utility costs for the Refrigerated Lean Oil Absorption Scheme exceeded those for the Expander Scheme, the Expander Scheme is recommended for recovery of LPG in the Demonstration Plant.

29842 (DOE/OR/03054—2, pp 61-71) **Characterizing wastewater and monitoring its treatment.** DiLeo, A.J.; Nicholas, D.M. 1980. NTIS, PC A07/MF A01.

In SRC-I. Quarterly technical report, October-December 1980.

A laboratory program was begun to identify likely contaminants in the wastewater from the SRC-I Demonstration Plant and to determine its treatability. Pilot plant wastewaters for characterization were obtained from GKT gasification of mineral ash residue from SRC-I operation, and coking, expanded-bed hydrocracking, and production of SRC-I. In addition, coal and SRC pile runoff wastewater and oily wastewater runoff from SRC facilities were obtained. On each sample, pH, oil and grease content, total organic carbon, chemical oxygen demand, specific ions (S^{2-}, CN^-, SCN^-, NH_4^+), and elemental levels of sulfur, nitrogen, carbon, and metals were determined. Significant progress has been made in wastewater characterization and wastewater simulation. Results of ongoing organic identification and quantitation by gas chromatography (GC), gas chromatography-mass spectroscopy (GC-MS), and liquid chromatography (LC) are reported for an SRC-I process recycle water (PRW) stream. A screen of polynuclear aromatics (PNAs) completed on all process wastewater samples has supplied evidence of up to four ring structures. In addition, measurements of trace metals in these samples were made, and preliminary anion and cation results are reported for low-organic wastewaters. A representative screening of the total phenolic content of all wastewater samples using the 4-aminoantipyrine method has been made. In addition, a Fort Lewis SRC-I PRW sample analyzed by GC-MS showed that 92% by weight of the total organics were phenolics. Completion of the physical-chemical pretreatment study has determined that simple pH adjustment is the most effective method of precipitating oils and metals from their respective wastewater streams. A Demonstration Plant wastewater stream composition has been defined in terms of global parameters, and component analysis and biological treatment studies are underway.

29843 (DOE/OR/03054—2, pp 73-111) **Equipment and coal unloading facility study.** 1980. NTIS, PC A07/MF A01.

In SRC-I. Quarterly technical report, October-December 1980.

A study has been conducted to determine the costs and schedule impacts of several alternate designs for a multi-purpose barge unloading facility serving the SRC-I Demonstration Plant. This study provides a list of barge-deliverable equipment, and discusses minimum construction dock designs, as well as construction dock designs expandable to coal unloading operations for 6000- and 30,000-ton-per-day (tpd) plants.

29844 (DOE/OR/03054—2, pp 113-131) **Evaluation of alternative slurry pumps, pipes, and fired heaters.** 1980. NTIS, PC A07/MF A01.

In SRC-I. Quarterly technical report, October-December 1980.

In the SRC-I Demonstration Plant, dry fine coal will be mixed with a process-derived solvent and pumped at reaction pressure to the coal dissolution section. To help select and design the equipment that will be used to pump, pipe, and heat the SRC slurry between the preparation and dissolver areas, Catalytic, Inc. conducted two studies for ICRC to compare alternative methods: (1) Pump/Piping Study. Six different methods that would minimize downtime and loss of plant capacity following equipment failure were compared. Equipment systems studied included pumps, piping networks, coal slurry/oil heat exchangers, and heater tubing passes. (2) Heater Study. Ten cases, including all-convective, radiant-convective, and electric heaters, were compared in areas such as cost, maintenance, and operation. The objective was to find the optimum piping configuration and heater type based on both technical and cost considerations. The recommendations are presented here in a combined report, since the selected alternatives from each study must match and total cost is significant. After all the cases for both studies were compared, the following designs were recommended: (1) Pump/Piping Study. A two-train system was chosen. Each train has straight-through flow from three pumps through three heat exchangers to three heaters having single 8-in. tube passes. Each train also has one spare to operate during pump failure and preventive maintenance. (2) Heater Study. A system consisting of six twin-cell, floor-fired, radiant-convective heaters, each having one 8-in. tubing pass, was selected.

29845 **(DOE/OR/13410—T2) IITRI-4.2.9: design, engineering, and evaluation of refractory liners for slagging gasifiers.** Bortz, S.A. (IIT Research Inst., Chicago, IL (USA)). 1978. Contract AC05-78OR13410. 9p. NTIS, PC A02/MF A01. Order Number DE81028351.

In this program, about 38 ft^3 (over 600 9-in. straight equivalents) of refractory will be tested during each run in the environment of a typical slagging gasifier. Status of the test facility is described. 9 figures. (DLC)

29846 **(DOE/OR/13410—T3) Design, engineering, and evaluation of refractory liners for slagging gasifiers.** Bortz, S.A. (IIT Research Inst., Chicago, IL (USA)). 1981. Contract AC05-78OR13410. 9p. NTIS, PC A02/MF A01. Order Number DE81026728.

The conditions found in vessels used in coal gasification require the use of dense and insulating refractory shapes and castables. Low iron, high alumina refractories are the presently preferred materials for coal gasification plants. Low SiO_2 and low Fe_2O_3 refractories are necessary to resist steam and CO. Fused cast, fully dense refractories are used to avoid corrosion and erosion by slag running down the walls. However, considerable research is required to establish optimum refractory systems and design methods for slagging gasifiers. This program is a first attempt at the required research. While there have been a number of programs to test refractories for slagging gasifiers, there have been none which have tested more than a few small specimens of each refractory or closely simulated gasifier conditions. On this program, approximately 38 cubic feet (over six hundred 9-inch straight equivalents) of refractory will be tested during each run in the environment of a typical slagging gasifier. By testing this large amount of refractory, material variations are averaged out, a closer approximation to liners for large gasifiers is achieved, and total refractories system performance can be studied.

29847 **(DOE/PC/30018—T1) Flash hydroliquefaction of coal. Quarterly technical progress report No. 1, September 30, 1980-December 31, 1980.** Falk, A.Y. (Rockwell International Corp., Canoga Park, CA (USA). Environmental and Energy Systems Div.). Jul 1981. Contract AC22-80PC30018. 40p. NTIS, PC A03/MF A01. Order Number DE81026607.

During Phase II of the program, the effectiveness of the reactor concept was demonstrated. Twenty-one reactor tests were made at nominal coal flow rate at 1/4 TPH. Twenty additional tests were made at a nominal coal flow rate at 1 TPH. It is clear that substantial liquid yields and high overall conversions are possible. Overall carbon conversions as high as 64% were obtained. Overall conversions of this level are required for balanced plant operation (complete carbon utilization) if the residual char is gasified to generate the process hydrogen. Carbon conversions to liquid products as high as 38% were obtained. The reactor is also sufficiently versatile to produce high carbon conversions to gases as well, with conversions as high as 62% having been obtained. During Phase II of the program, a high-pressure product recovery system was designed and installed as part of the 1-TPH system. Prior to installation of these systems, 36 additional short-duration (~ 10 min) reactor tests were made. The purpose of these tests was to better define the influence of reactor operating conditions on product yield and quality. Forty reactor tests were conducted utilizing the new high-pressure product recovery system. The new systems functioned well after an initial shakedown, and they allow for better sepration and recovery of the products. Tests of 1-hr duration, limited by the char receiver tank capacity, can now be conducted relatively routinely. The commercial potential of the process was assessed under a subcontract to Scientific Design, Inc. This evaluation showed a very high thermal efficiency and favorable economics when compared with other liquefaction processes. Many potential advantages of the process were noted. However, most of these advantages remain to be demonstrated.

29848 **(DOE/PC/30021—T5) Catalyst and reactor development for a liquid phase Fischer-Tropsch process. Quarterly technical progress report, 1 October-31 December 1980.** Brockington, J.W.; Dyer, P.N.; Pierantozzi, R.; Bauer, J.V. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Jan 1981. Contract AC22-80PC30021. 86p. NTIS, PC A05/MF A01. Order Number DE81029117.

Air Products, under contract to the DOE, has begun a three year program in Catalyst and Reactor Development for a Liquid Phase Fischer-Tropsch Process. The program contains four major tasks: (1) Project Work Plan, (2) Slurry Catalyst Development, (3) Slurry Reactor Design Studies, and (4) Pilot Facility Design. Task 1 has been completed with the preparation of a Project Work Plan describing in detail the methods and technical approach to be used. Task 2 has four sub-tasks. The first segment of the background studies deals with the effect of metal particle size on product selectivity and is included in this report. Based on these background studies, ten of twenty modified traditional Fischer-Tropsch catalysts to be prepared and slurry phase tested have been identified. Slurry reactor specifications have been finalized and a comprehensive product analysis scheme and data handling system has been established. Forty of the fifty supported metal cluster catalysts to be prepared and gas phase screened have been identified. Two metal cluster catalysts have been prepared. A detailed experimental plan for the first phase of Task 3 using a 5-inch diameter cold flow reactor simulator has been completed.

29849 **(DOE/PC/30302—3) Synthetic fuel aromaticity and staged combustion. Third quarterly technical progress report, April 1-June 30, 1981.** Levy, A.; Longanbach, J.R.; Chan, L.K. (Battelle Columbus Labs., OH (USA)). 30 Jul 1981. Contract AC22-80PC30302. 24p. NTIS, PC A02/MF A01. Order Number DE81024205.

Battelle and Gulf analytical data for narrow SRC II distillation cuts have been compared in detail and found to show similar trends. Improvements are continuing to be made in the analytical methods used to characterize the SRC II distillation cuts before and after pyrolysis. The precision of the basic nitrogen procedure has been checked and found to be within +- 1% of the basic nitrogen content. An improved NMR method for structural parameter characterization is being implemented. An aromatic GC standard has been prepared for use in the simulated distillation by GC analysis. An improved GC column is being used to clearly show the sample changes which occur during pyrolysis. Exploratory experiments have been carried out to determine the conditions of time and temperature under which the SRC II distillation cuts will pyrolyze. The experiments were conducted by vaporizing the SRC II cut, mixing the fuel vapor with helium, and then passing the mixture into the heated reaction zone. A complete set of analyses was obtained on the liquid products from pyrolysis at 800 C of a 200 to 250 C SRC II distillation cut using two different residence times. Although the changes in one sample occurred as expected, difficulty in characterizing and controlling the time-temperature exposure of the sample have complicated interpretation of the data obtained

at the shorter residence time. Gas analyses showed the presence of hydrocarbons, HCN, NH_3 and N_2 in the gas phase.

29850 (DOE/PC/40771—1) **Fischer-Tropsch synthesis in slurry reactor systems. Technical progress report for period ending July 31, 1981.** Satterfield, C.N.; Huff, G.A. Jr. (Massachusetts Inst. of Tech., Cambridge (USA)). 1981. Contract FG22-81PC40771. 7p. NTIS, PC A02/MF A01. Order Number DE81027010.

This is the first technical progress report on this grant, which had an effective date of initiation of March 9, 1981. During this period preliminary experimental results were obtained on the effects of reactant transport across the gas-liquid interface on synthesis gas conversion and product selectivity, utilizing an iron catalyst in a laboratory-scale, well-mixed slurry reactor.

29851 (EPRI-WS—79-238-Vol.2, pp 18.1-18.12) **Texaco coal gasification technology.** Siegart, W.R. May 1981. NTIS, PC A19/MF A01.

In Conference proceedings: synthetic fuels-status and directions. Volume 2: sections 18-appendixes.

The Texaco process involves grinding the coal, slurrying with water, pumping into the generator where the coal-water slurry is mixed with oxygen through a burner and the reaction occurs in a refractory-lined vessel. Slag is removed and heat recovered. Sulfur is removed as H_2S by any of several commercially available processes and the gas directed to its end use. As the gasifier can operate up to 1,200 psig the change of pressure depends on overall economics and gas end use. Texaco is currently committing about $10 M to expansion and improvement at our Montebello Laboratory to continue our research and development. As part of an ongoing development program to improve the Texaco coal gasification process's performance and efficiency, Texaco has the following projects underway: (1) optimizing coal/water slurry feed concentrations by improving the wet feed system, (2) optimizing gasifier operation for high moisture content coals such as lignite, (3) continue a study program to increase the life of materials of construction, (4) improve the reaction heat steam generator (syngas cooler) design to maximize the overall thermodynamic efficiency, (5) optimize the particle grind size as it relates to gasification efficiency and maximum slurry concentration, (6) evaluate the economic benefit of gasifier design features, (7) improve gasification instrumentation and control devices, (8) investigate scale-up development to allow gasifier modules larger than 1,000 tons per day.

29852 (EPRI-WS—79-238-Vol.2, pp 19.1-19.19) **Experiences with the Texaco process of coal-dust pressure gasification using the Ruhrchemie/Ruhrkohle technical version.** Cornils, B.; Specks, R. May 1981. NTIS, PC A19/MF A01.

In Conference proceedings: synthetic fuels-status and directions. Volume 2: sections 18-appendixes.

The Ruhrchemie/Ruhrkohle variant of the Texaco Coal Gasification Process (TCGP) has been on stream since 1978. As the first demonstration plant of the second generation it has confirmed the advantages of the simultaneous gasification of coal at higher temperaures, under elevated pressures, using finely divided coal, and feeding the coal as a slurry in water. The operating time so far totals 6500 hours. Nearly 36,000 tons of coal have been converted to syngas with an average composition of 55% CO, 33% H_2, 11 % CO_2 and 0.01 % of methane. We feel that all technologists would agree that a modern, economic coal gasification process as a process of the second generation - aimed at supply the chemical industry with syngas - should meet the following requirements: The gasification should take place under high pressure in order to facilitate high space/time throughputs and reduce reactor volume requirements. The syngas would be delivered at appropiate pressure levels, saving costs for a possible syngas compression for downstream syntheses. The gasification should be a high reaction temperatures to avoid tar production and suppress methane formation, thus ensuring low gas purification costs. Only high temperatures accelerate the gasification process and allow high carbon conversions and high carbon efficiencies. Additionally the handling of the ty of utilizing a finely divided, powdered coal feedstock (coal dust) is an attractive feature as modern mining technology is producing increasing amounts of fines, as a consequence of the increasing degree of automation and mechanisation. Coal dust as gasification feedstock also reduces quality requirements and facilitates the gasification of coal of all qualities, e.g. those with large ash contents.

29853 (EPRI-WS—79-238-Vol.2, pp 20.1-20.23) **Cool water coal gasification program: a demonstration of gasification-combined cycle technology.** Walter, F.B.; Kaufman, H.C.; Reed, T.L. May 1981. NTIS, PC A19/MF A01.

In Conference proceedings: synthetic fuels-status and directions. Volume 2: sections 18-appendixes.

Demonstrating new synfuels technology for the utility industry on a commercial scale is vitally important to solving the US energy situation. Several major organizations are well advanced with a program to demonstrate on a large scale one of the most promising new methods of using coal in an economical and environmentally acceptable manner. This $300 million dollar demonstration facility will charge 1000 tons per day of coal to produce 100 MW of electricity into an existing utility grid. It will couple the proven Texaco Coal Gasification Process with standard General Electric Company combined cycle gas and steam turbine components. Oxygen will be supplied and gas cleanup will be accomplished with commercially proven processes. The entire facility will be closely integrated and controlled to demonstrate both baseload and load following capability. The utility operating know-how of Southern California Edison, the engineering and construction ability of Bechtel, the research coordination of EPRI, the combined-cycle manufacturing experience of General Electric, and the process design and operating knowledge of Texaco are all fully committed to the success of this Cool Water Coal Gasification Program. Production engineering is in full progress. Start-up is anticipated before the end of 1983.

29854 (EPRI-WS—79-238-Vol.2, pp 21.1-21.16) **Application of the S/K coal gasification process in power generation.** Voelkel, H.K.; Eckstein, G.; Vogt, E.V. May 1981. NTIS, PC A19/MF A01.

In Conference proceedings: synthetic fuels-status and directions. Volume 2: sections 18-appendixes.

The Shell-Koppers Process, an autothermic gasification process, is based on the principle of entrained bed gasification at elevated pressure and high flame temperatures. Gasifying agents (blast) are oxygen (or air) and steam if required. The product is a synthesis gas i.e. a gas mixture consisting of carbon monoxide and hydrogen. The S/K Process satisfies essential requirements put on a modern technology: high carbon conversion rate, suitability for various coal qualities, large unit capacity, high thermal efficiency, good load following characteristics, environmental acceptability, and wide pattern of applications. The milling of coal to a fine dust as well as the gasification under pressure and the high flame temperatures result in carbon conversion rates of more than 98 % without the need to re-circulate the fly-ash for improving this conversion rate. The process is suitable or the complete gasification of a wide variety of solid fuels such as most types of coal, petroleum coke and coal/oil mixtures. Unlike fixed-bed or fluidized-bed processes in the S/K Process there is almost no limitation on the coal as to ash fusion behavior or caking properties. The elevated pressure, the high flame temperatures and the coal feed in form of fines enable an almost complete gasification of the coal within a very short residence time. High throughput capacities are attainable in a relatively small volume gasifier. The medium-term aims are individual gasifiers at a coal throughput of appr. 100 t/h producing each a daily synthesis gas quantity of 4.8 million Nm^3.

29855 (EPRI-WS—79-238-Vol.2, pp 23.1-23.19) **Ruhr 100: development work on the pressurized Lurgi gasifier in Dorsten.** Lohmann, C.; Langhoff, J. May 1981. NTIS, PC A19/MF A01.

In Conference proceedings: synthetic fuels-status and directions. Volume 2: sections 18-appendixes.

The increase in the process pressure in Ruhr 100 allows a higher gasifier throughput. G. Baron showed by bench scale tests and theoretical studies that, due to the higher partial pressure of the hydrogen, the methane content of the product gas is almost doubled if the process pressure is raised from 25 bar to 100 bar. An increase in the methane content from approx. 10 % (by volume) at 25 bar to 16 to 18 % at 100 bar has been predicted. As a result, approx. 54 % of the methane contained in the product gas on a SNG plant would be produced primarily as raw gas by the gasifier.

Further, the heat liberated by the formation of methane in the gasifier reduces the quantity of heat which must be generated by the partial combustion of coal and consequently, reduces the coal and oxygen consumption. A considerable decrease in the tar content of the raw gas has also been predicted. Finally, a process pressure of 80 bar or more eliminates the need for a compressor station before the SNG produced is pumped into the transmission system.

29856 (EPRI-WS—79-238-Vol.2, pp 24.1-24.30) **British gas/Lurgi slagging gasifier and its relevance to power generation.** Sharman, R.B.; Scott, J.E. May 1981. NTIS, PC A19/MF A01.

In Conference proceedings: synthetic fuels-status and directions. Volume 2: sections 18-appendixes.

The most developed and widely used fixed bed pressure gasification systems are based on the Lurgi Gasification Process. The British Gas/Lurgi Slagging Gasifier results from the joining together of British Gas Corporation and Lurgi company technology. The British Gas Slagging Gasification technology offers significant advantages over dry bottom Lurgi and other fixed bed gasification systems. It is also true to claim that the slagging gasifier has more advantages than disadvantages when compared with entrained gasifiers and these advantages are sufficient to give it an economic advantage in most process situations. There are other fixed bed and entrained systems under development but these are not short to medium term options and only in the longer term will it become clear whether or not these developments offer sufficient economic advantage to compete with or displace the British Gas/Lurgi Slagging Gasifier. The environmental impact of the process is discussed and plans for commercialisation are considered. One of the important features of the paper is the relevance of the Slagging Gasifier for power generation. Information is provided on the extent to which the gasifier responds to imposed load variations. This has been demonstrated on a commercial scale at the British Gas Corporation Westfield Development Centre. The British Gas/Lurgi Slagging Gasifier is at an advanced stage of development and can now be regarded as ready for commercial exploitation. It is particularly suitable for high volatile, unreactive, bituminous coals and can find wide application in the areas of SNG manufacture, combined cycle power generation, medium Btu and synthesis gas fields.

29857 (EPRI-WS—79-238-Vol.2, pp 25.1-25.20) **Saarberg-otto gasifier: status, application, and further development.** Fussman, G.; Rossbach, M. May 1981. NTIS, PC A19/MF A01.

In Conference proceedings: synthetic fuels-status and directions. Volume 2: sections 18-appendixes.

The companies Saarbergwerke AG, Saarbruecken and Dr. C. Otto & Comp. GmbH, Bochum, have developed a process for the entrained gasification of coal under pressure. The design for a demonstration plant was started in 1976. In December 1979 the plant was put into operation at Voelklingen-Fuerstenhausen. It is designed for a coal throughput of 264 tons per day (290 short tons per day) and an operation pressure of 25 bar (365 psi). In the oxygen-blown operation, the gasification produces approximately 550,000 m^3 (standard) per day of gas (20.6 MM SCFD). The project is part of the Energy Research and Development of the Federal Republic of Germany. The cost for the design and construction amounted to approximately DM 54 MM, 75 % of which was sponsored by the Federal Ministry of Research and Technology. The primary emphasis of the research and development program are coal feeding and distribution, cooling of the gasifier, slag discharge and dust removal from the syngas. An extensive test program includes running of the plant at various pressures to determine characteristic process data, maximum plant throughput and conversion efficiencies. The test runs also serve for the optimization of the conversion efficiency and process economics for different coals. The knowledge gained will serve as the basis for design, construction and operation of prototype and commercial scale gasification plants.

29858 (EPRI-WS—79-238-Vol.2, pp 26.1-26.27) **KGN fixed-bed gasifier and the planned gasworks Riedelland.** Dorstewitz, U.; Bauer, J.; Kaimann, W.; Schauerte, H. May 1981. NTIS, PC A19/MF A01.

In Conference proceedings: synthetic fuels-status and directions. Volume 2: sections 18-appendixes.

The KGN gasifier can be operated without or with pressure. Air and steam serve as gasification agents for the production of producer gas or oxygen and steam for the production of syngas. The pilot plant, a simplified flow diagram of which is shown in Fig. 10, has been erected and operations have started recently. The expected gas quality is given. Both the producer gas and the synthesis gas are free of tar. The producer gas is of usual composition and has sufficient heating value. Due to the fact that it is free of tar, it can be desulfurized at temperatures of about 285°F by means of activated coal, which is most important when used in conjunction with a combined cycle. The syngas contains less methane but considerably more hydrogen than is usual in fixed-bed gasification. This means that the H_2/CO ratio of 2.3 is favorable for further synthesis purposes. The high hydrogen contents result from the recycling and cracking of hydrocarbons including methane. It is a disadvantage of the fixed-bed gasifier that it needs sized coal. This means that coal fines have to be compacted. As already mentioned, briquettes made of anthracite fines were used as feedstock for the pilot plant to produce water gas. As a result, the flow behavior in the reactor was positively influenced. However, during the first trails, the fire resistance quality of the briquettes was not fully satisfactory. By modifying manufacturing methods, it will be possible to produce briquettes of satisfactory quality for large size fixed-bed gasifiers.

29859 (EPRI-WS—79-238-Vol.2, pp 27.1-27.12) **C-E coal gasification process: commercial outlook for the 1980s.** Knust, R.B. May 1981. NTIS, PC A19/MF A01.

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A substantial coal gasification market appears to be on the horizon in the 1980s. The C-E process is one of the second generation technologies presently in the advanced stages of development. Commercial plant studies indicate potential cost benefits for this system which will make it an economically attractive option for electric power production in the 1980s. In addition certain industrial applications appear to be economically feasible as the price of oil and gas increases sharply and the availability of both become uncertain. A word of caution should be exercised on these, and any other cost comparisons for advanced coal conversion systems. We do know actual costs for conventional plants equipped with flue gas scrubbers-that's our business. But no large-scale integrated coal gasification plant has yet been built, so those costs are somewhat speculative. Nevertheless, they are based on thorough studies made by a long term major supplier of power plant equipment to the utility industry. We believe that the in-depth studies that support these cost estimates are sufficient justification to warrant federal support of a demonstration plant in order to establish operatinal reliability on a commercial scale. Once this is done we believe electric utility company investments in this type of plant will follow.

29860 (EPRI-WS—79-238-Vol.2, pp 28.1-28.26) **Westinghouse gasification program.** Holmgren, J.D.; Seglem. C.E.; Salvador, L.A.; Dyos, M.W. May 1981. NTIS, PC A19/MF A01.

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When comparing the Westinghouse fluidized bed gasifier to other technologies several inherent advantages become apparent: Moderate operating temperatures, minimize materials selection problems and extend refractory life by an order of magnitude. Operation at moderate temperature is more efficient because less carbon in the coal is combusted to provide the heat required for devolatilization and gasification reactions. Moderate temperatures utilized in the fluidized bed process are high enough to avoid tar and oil production, often encountered in the lower temperature fixed-bed units, and thereby avoids potential in-plant toxicity hazard and a loss in efficiency because of the tar-oil cleanup systems required. Any coal can be processed: caking or noncaking, high or low ash, high or low sulfur, reactive or nonreactive, lignite to bituminous. Both the entrained or fixed bed gasification processes have restricted application because of their inability to handle high mositure coals, high ash coals or highly caking coals. The fluidized bed rejects ash as a dry, granular, and environment all benign material rather than as a slag or clinker. Run-of-mine coal as ground can be handled with complete fines utilization and no fines rejection because of size, as occurs in the fixed-bed processes. Fluidized-bed

operation with its large inventory of carbon in the bed is inherently stable and easy to control yet responds readily to process load demand changes and can readily be operated at 25 percent load. Operation at very modest steam requirements compared to both fixed and entrained beds result in the lowest produced gas cost of any of the second generation processes.

29861 (EPRI-WS—79-238-Vol.2, pp 29.1-29.19) **Rheinbraun high-temperature Winkler (HWS) process.** Adlhock, W.; Theis, K.A. May 1981. NTIS, PC A19/MF A01.

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Based of the experience gained so far Rheinbraun has decided to erect a commercial-sized HTW-demonstration plant for gasifying dry lignite of 100 metric tons per hour. As shown in principle in figure 11, following an appropriate gas treatment the produced synthesis gas is transported to our subsidiary Union Rheinische Braunkohlen Kraftstoff AG at Wesseling (UK Wesseling) where it is used for methanol synthesis thus substituting the synthesis gas generated so far from crude oil products. A simplified flow sheet of the methanol plant on lignite basis is shown in figure 12.

29862 (EPRI-WS—79-238-Vol.2, pp 31.1-31.19) **U-gas demonstration plant program.** Patel, J.G.; Loeding, J.W. May 1981. NTIS, PC A19/MF A01.

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A joint program to design, construct, and operate an industrial fuel-gas demonstration plant in Memphis, Tennessee, has been undertaken by Memphis Light, Gas and Water Division (MLGW) and the US Department of Energy (DOE). The facility will use the Institute of Gas Technology's U-GAS process to produce fuel gas equivalent to 50 million cubic feet per day of natural gas. The plant will use as feed 3200 tons/day of western Kentucky coal. To date, main activities have been the design of the plant and - in support of the design - operation of the U-GAS pilot plant, the compilation of an environmental report, and estimation of plant cost. This constitutes the work done under Phase I; Phases II and III, which will conclude detailed plant design and construction in Phase II and plant operations in Phase III, have been the subject of recent successful negotiations between DOE and MLGW. The cost of Phases II and III will be shared between the two signatories. The goal of the demonstration plant program is to test the feasibility of a multiple-user coal gasification plant located in the southwest corner of Memphis, Tennessee.

29863 (EPRI-WS—79-238-Vol.2, pp 33.1-33.15) **Vew coal conversion process in a combined-cycle power plant.** Hirschfelder, G. May 1981. NTIS, PC A19/MF A01.

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Based on our considerations of application studies for electric power generation from coal and on results of our test runs we believe, that the VEW coal conversion process or the partial gasification with an airblown pressurized entrained flow gasifier has some advantages, which justify the construction of large scale plants: Partial gasification and char combustion in a boiler furnace allow nearly 100 % carbon utilisation. Because of the partial gasification, the air-blown entrained gasifier produces a gas with such a sufficient heating value that combustion is possible without auxiliary firing or addition of oxygen. The operation of the VEW-partial gasification plant has shown that satisfying results are attainable in an air-blown entrained gasifier. The partial gasification in an air-blow process allows use of a partially cooled refractory lining. The waste heat losses at the gasifier outlet are lower than the losses of the total gasification. The supplementary-fired boiler allows a steam cycle lay-out with normal steam conditions. If the waste heat recovery boiler at the gasifier outlet does not allow the generation of superheated steam, perhaps because of material problems, the supplementary-fired boiler nevertheless enables superheat in the produced steam. The overall plant efficiency is higher than in a total gasification process especially because of the lower auxiliary power consumption.

29864 (EPRI-WS—79-238-Vol.2, pp 34.1-34.32) **Baseload gas turbines for coal-fueled utility service.** Grevstad, P.E. May 1981. NTIS, PC A19/MF A01.

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Fortunately for the power industry, gasifiers are subjects of intensive development for non-power needs. Petrochemical, synthetic fuels and fertilizer industries. Today's gas turbines do not have the reliability, durability nor the performance required for baseload service; further, they cannot use coal derived fuels while meeting emission requirements in an economic manner. Today's gas turbines are the result of an evolutionary process aimed at optimizing the equipment for peaking power service. The economic drivers of this market (minimum first cost and a low number of operating hours per year) have made today's gas turbines a different kind of machine from that required for baseload, combined-cycle service. Existing peaking power gas turbines operate with turbine inlet temperatures up to approximately 2000°F. Some of these machines have achieved reliable, long term operation, but only by reducing temperatures below 2000°F and utilizing very clean fuels. However, to be economically viable, the gas turbine for coal gasification combined-cycle systems must achieve a threshold performance level associated with approximately 2000°F operating tempratures. The coal gasification combined-cycle is the only near-term system capable of achieving a significant reduction in heat rate and thereby reduced operating costs. The gas turbine's inherent improvement capability for achieving lower heat rates is becoming more important as raw fuel prices escalate. The gas turbine is the weak link in the chain of events leading to utility acceptance of the coal gasification combined cycle. Particularly its deficiency in life and reliability in the context of baseload service.

29865 (EPRI-WS—79-238-Vol.2, pp 35.1-35.35) **High-pressure coal gasification combined-cycle power generation.** Krieb, K.H.; Heyn, K. May 1981. NTIS, PC A19/MF A01.

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Very early STeag decided on a program characterized and defined by the following criteria: Opening-up of the combined gas turbine/steam turbine process to hard coal; pressurized gasification at highest possible pressure level; direct coupling of coal conversion to the combined-cycle section, implying - with respect to thermodynamics - most effective use of the sensible heat contained in the coal gas for the process; and pressurized fuel gas purification implying comparatively cheap desulphurization, i.e. when compared to flue gas desulphurization. The KDV Process is characterized by: Gasification of lump coal (weakly caking low-grade coal) by means of air and steam at 20 bar in five Lurgi-type fixed-bed gasifiers of 3.4 m inside diameter each; cleaning of raw gas with tar and dust separation by means of water scrubbing, and cooling down from 550°C to 165°C; reduction of clean-gas pressure to 10 bar by means of a small sized split-flow turbine; combustion of coal gas in two pressurized boiler systems at 10 bar for production of up to 340 t/h of steam for the 96 MW steam turbine; pressure reduction and cooling of the flue gas via a 74 MW four-stage gas turbine; further cooling of the flue gas to 170°C in a wastegas feedwater preheater; compression of combustion and gasification air to 10 bar by means of a gas-turbine compressor set. The coal conversion plant and the combined cycle unit are coupled by expansion turbine and the gasification air re-compressor.

29866 **(FE—2013-14) Catalytic coal liquefaction. Quarterly report, July-September 1980.** Weller, S.W. (State Univ. of New York, Buffalo (USA)). 1980. Contract AC01-76ET10518. 21p. NTIS, PC A02/MF A01.

MoO_3-Al_2O_3 catalysts over the loading range 3.9 to 14.9 wt% MoO_3 have been studied with respect to BET surface (before and after reduction), O_2 chemisorption at -78°C, redox behavior at 500°C, and activity for cyclohexane dehydrogenation at 500°C. The BET areas for the unreduced catalysts are consistent with a monolayer model for MoO_3 on Al_2O_3; for reduced catalysts, the appropriate model would be porous or finely crystalline MoO_2. Catalysts with $< 11\%$ MoO_3 are incompletely reduced to MoO_2 after 6 hours in flowing H_2 at 500°C. After correction is made for the actual extent of reduction, plausible relations are obtained for both O_2 chemisorption and cyclohexane dehydrogenation vs. MoO_3 loading (corrected). The sites responsible for both O_2 chemisorption and for dehydrogenation activity may be surface Mo^{4+} ions. Hydrotreating of 1-methyl naphthalene, as a multifunctional screening test for liquefaction catalysts, has been studied at 450°C for $SnCl_2$ and a

group of 6 commercial $Co/Mo/Al_2O_3$ catalysts. AT 450°, SnCl is a very poor catalyst for ring hydrogenation (RHG), but it catalyzes hydrodemethanation (HDM). By contrast, all the $Co/Mo/Al_2O_3$ samples catalyze RHG but not HDM. Differences can be detected in the RHG activity of different $Co/Mo/Al_2O_3$ catalysts, but the rank ordering is different for catalysts tested in the as-received (oxide) condition and those tested after presulfiding. The extent of RHG correlates well with the final (cold) autoclave pressure.

29867 (IRT—19600/1-Rev.1) Materials-process-product analysis of coal process technology. Volume III. User's guide to the MPPM. Final report for project Phase III. (International Research and Technology Corp., McLean, VA (USA)). 15 Aug 1979. Contract AC01-78ET12300. 203p. NTIS, PC A10/MF A01. Order Number DE81026451.

The Materials-Process-Product Model (MPPM) for coal conversion technologies, developed under a previous contract for the Department of Energy, has been modified to improve its versatility and flexibility for use in systems and policy analysis and the data base has been expanded and updated. The model consists of: a data base for coal-related materials and coal conversion processes; and an algorithmic structure that facilitates systematic evaluation of coal conversion process systems in response to exogenously specified variables such as tax policy, environmental limitations, and changes in process technologies and costs. The model is implemented as an interactive program. The user can easily include new process data, revise existing data, and introduce exogenous data related to policy options. Sensitivity analyses are readily performed on parameters such as coal sulfur content, effluent limitations, and process performance parameters. The model is currently installed and operational on the DOE, Energy Information Agency Computer in Rockville, Maryland, on IBM-370 series machine. It is also available on the CDC CYBERNET system. Volume I of this report contains a summary of work accomplished on the current contract. Volume II, the appendices, contains updated information on the model structure and algorithms. Volume III is an updated User's Manual.

29868 (LBL—12920) Coal-liquefaction research. Semi annual progress report, October 1, 1980-March 30, 1981. Heinemann, H. (Lawrence Berkeley Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01. Order Number DE81028909.

This project is aimed at examining the differences between Fischer-Tropsch reactions carried out in a slurry reactor on the one hand and in a fixed bed reactor on the other hand. There are two differences between slurries and fixed beds: (1) in a slurry reactor, less catalyst deactivation is observed, even at low H_2/CO ratios; (2) the product distributions are different: higher relative amounts of heavy products are produced in the slurry. Both of these differences have been confirmed experimentally. An earlier phase of this project was concerned with temperature control in the reactors. The present phase centers on an investigation of mass transport phenomena. The experiments have been aimed at measuring mass transfer coefficients and reaction kinetics, which will be used in a model of the slurry reactor. Obtaining data has been difficult, for two mechanical reasons. First, the flow controllers have not been functioning properly, and second, the catalyst tends to cake, and sometimes plug the reactor. Experiments with a glass column, the geometry of which is similar to that of the pressure slurry reactor have led to the design of baffles that break up clumps of catalyst. The data taken allow us to draw some conclusions about the Fischer-Tropsch slurry system.

29869 (LBL—12933) Chemistry and morphology of coal liquefaction. Quarterly report, January 1-March 30, 1981. Heinemann, H. (Lawrence Berkeley Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01. Order Number DE81028899.

In the course of observing by means of Auger spectroscopy graphite gasification reactions catalyzed by metals, it has been found that in the presence of hydrogen, nickel appears to diffuse from the surface into the bulk of the graphite. When potassium is deposited on graphite, it is volatilized above 400°C. Surprisingly the production of methane and carbon dioxide from the reaction of graphite and steam was catalyzed by potassium at as low a temperature as 250°C. It has been shown that literature on the alkylation of benzene with synthesis gas is erroneous and that the products reported are due to Lewis acid catalyzed cracking of benzene. A novel cobalt mediated, reversible cleavage of a vinyl-hydrogen bond has been discovered. All products from the thermal decomposition of tetralin have been identified. The stereochemistry of cis-1, 2 dihydrotetralin was determined. In the utilization of the water gas shift reaction as a reducing agent for model coal compounds it has been found that tributylphosphine ligands increase the life of transition metal hydride catalysts. Rates of demetallation of high metal content gas oils over cobalt-molybdena-alumina catalysts were measured for vanadium and iron. Kinetic analysis is under way. It is clearly shown that pore plugging of the catalyst occurs early and results in deposition of the metals on the external catalyst surface.

29870 (ORNL/TM—7915) H-Coal product physical properties measurement. Final report. Lee, D.D. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01. Order Number DE81029095.

Rheological and density measurements have been made on the H-Coal PDU reactor effluent samples from run PDU-10, periods 27B, 34A, 42A, and 43A, which used Wyodak coal. The characterization was done in the ORNL Coal Liquids Flow System (CLFS) at 719 K and 19.3 MPa, which closely approximated the conditions in the H-Coal PDU reactor at the time the samples were taken. Under these conditions, the apparent viscosities of the samples at a shear rate of 300 s^{-1} were 2.1, 4.0, 2.5, and 1.5 mPa s (cP), respectively. The corresponding densities were 0.908, 0.985, 0.882, and 0.951 g/cm^3. The rheological data were fitted to both power law and Bingham plastic models. Samples 27B and 34A were described almost equally well by both models, while samples 42A and 43A were better described by the Bingham plastic model. The apparent viscosities appeared to correlate to the amount of solids in the samples.

29871 (TVA/OGM/OC—81/7) Conceptual design and assessment of a coal-asification commercial demonstration plant. Volume 2: Texaco gasifier. Final report. (Bechtel National, Inc., San Francisco, CA (USA)). Sep 1980. 380p. C. Order Number DE81903582.

This report presents the results of Bechtel's conceptual design and techno-economic assessment of a plant producing medium-Btu gas utilizing the Texaco coal gasification process. A large number of alternatives were investigated to determine which combination of technically or commercially proven processes will produce medium-Btu gas at the lowest cost. Comparison of different technologies for the various process steps resulted in a tentative selection of process equipment. These selections were then examined from the standpoint of operational reliability, capital and operating costs, compatibility with the Texaco process, technical suitability, and commercial availability. Once the baseline combination of processes was established, a coal receiving and handling system was devised, and a preliminary plot plan was established for the overall facility, including a suggested layout of the process area. Tradeoff studies were performed to determine the capital and operating cost differences associated with upgrading the coal feed to the plant, utilization of different oxygen purities, changes in the sulfur content of the product gas, changes in the delivery pressure of the product gas, production of sulfur or sulfuric acid as a byproduct, and lowering of the CO_2 level in the product gas. Other studies examined the sensitivity of the baseline case to variations in coal costs, capital and operating costs, operating stream factor, construction period, and operating life of the plant. Capital and operating cost estimates and corresponding product gas costs were completed for selected process combinations.

29872 (UCRL—85839) Designing process wells for an underground coal-gasification environment. Thompson, D.S. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 20p. (CONF-810923—7). NTIS, PC A02/MF A01. Order Number DE81028434.

From 7. underground coal conversion symposium; Fallen Leaf Lake, CA, USA (8 Sep 1981).

Recent large-scale field experiments designed to advance the state of underground coal gasification (UCG) technology have

forced the recognition of some critical uncertainties associated with the UCG process. Among the most important of these uncertainties occurs in attempting to define the reaction zone geometry. Batch processing of a flat-lying coal seam between two process wells involves complex flow patterns, any number of separate reaction zones, and interactions with surrounding media. All of these factors have significant impact on the overall efficiency of the UCG process, and all of them in turn are strongly affected by success or failure in maintaining the integrity of the process wells. The reasons why process well integrity is so important are covered here in a review and evaluation of significant data generated from various field tests, including identification of well failure mechanisms. We observe a close relationship between process well behavior and process performance, which leads us to conclude that reliable process well performance is critical in establishing and maintaining control over the UCG process. As a logical extension of this evaluation, we develop design and performance criteria for UCG process wells. Applications to the next generation of field tests are presented in the form of proposed design features for UCG process wells, features intended to prevent the failure modes that have occurred in past field experiments.

29873 **(UCRL—85919) Soviet UCG experience specifically related to field experiments in the United States.** Olness, D.U. (Lawrence Livermore National Lab., CA (USA)). 8 Jul 1981. Contract W-7405-ENG-48. 6p. (CONF-810923—6). NTIS, PC A02/MF A01. Order Number DE81028642.

From 7. underground coal conversion symposium; Fallen Leaf Lake, CA, USA (8 Sep 1981).

During the past 8 years, some 20 underground coal gasification experiments have been conducted in the United States. Most of these experiments produced gas with a heating value in excess of 100 kJ/mole, but various problems have prevented the achievement of ideal results. For example, at Hoe Creek there were problems with hole failure and override, and at Hanna some of the reverse-burn links either lay higher in the seam than was anticipated or required an excessively long time for completion. Publications describing over 35 years of experience in the Soviet Union reveal that the difficulties encountered in the United States have occurred in the Soviet Union as well. This report discusses the Soviet experience with problems similar to those observed in the United States.

29874 **Kinetic studies on the reactions involved in the hot gas desulfurization using a regenerable iron oxide sorbent. Part I.** Tamhankar, S.S.; Hasatani, M.; Wen, C.Y. (Univ. of West Virginia, Morgantown). *Chemical Engineering Science* ; **36**: No. 7, 1181-1191(1981).

The reactions of iron oxide (45 wt. % Fe_2O_3 55 wt. % SiO_2) with a hot gas containing H_2, CO and H_2S were investigated over a temperature range of 600 to 900°C. Preliminary studies indicated initial fast reduction of Fe_2O_3 to spongy iron, which reacted slowly with the H_2S to form iron sulfide. Hence, reduction with H_2-CO mixture and subsequent sulfidation with H_2S were studied separately. Results of experiments in a thermogravimetric analyzer are reported. The data are correlated using the grain model. The intrinsic rate constants are obtained from the data on the reactions of smallest particles at low conversions, and the effective diffusivities estimated from the data on the reactions of pellets. The activation energies for reduction and sulfidation are found to be 14.8 and 3.3 kcal/mole, respectively. The overall rate for any particle size could then be represented by an approximate equation obtained essentially by the summation of the two resistances, chemical reaction, and pore diffusion.

29875 **Process for separating coal synthesized methane from unreacted intermediate and contaminant gases.** Barker, R.E.; Scott, C.D.; Ryon, A.D. (to Dept. of Energy). US Patent Application 200,799. 27 Oct 1980. 10p.

Gas produced from coal and containing CH_4, CO, CO_2, H_2 and H_2S is contacted with CO_2 scrub liquid to form (1) a liquid CO_2 stream containing as solutes CH_4, H_2S and minor portions of the CO and H_2, and (2) a gas stream containing CO_2 and major portions of the CO and H_2, the CO and H_2 in this stream being recycled to the means which produces gas from coal, and CO_2 in the stream being recycled to the scrub liquid. The solute-bearing liquid CO_2 stream is fractionated into (1) a liquid CO_2 stream containing CH_4 and H_2S, and (2) a H_2/CO gas stream which is recycled into contact with the scrub liquid. The last-mentioned liquid CO_2 stream is fractionated into (1) a CH_4/CO_2 gas stream the CO_2 of which is recycled to the scrub liquid, and (2) a liquid CO_2 stream containing H_2S, and CO_2 of this stream is also recycled to the scrub liquid.

29876 **(DOE/ET/13060—T3(Vol.5)) Pipeline-gas Demonstration Plant. Phase I: Demonstration Plant engineering and design. Volume 5. Plant Section 300: Gasification.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). [nd]. Contract AC01-77ET13060. 56p. (FE—2542-38(Vol.5)). NTIS, PC A04/MF A01. Order Number DE81028466.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. One of the major efforts of Phase I is the completion of the process design and the project engineering design of the Demonstration Plant. This design effort has been completed. This is Volume 5 of 24 which reports the design of Plant Section 300 - Gasification. In Plant Section 300, gasification of the coal feedstocks is achieved in the British Gas/Lurgi Slagging Gasifier. The gasifier operates at 450 psia, and the ash is removed as a molten slag. The coal is converted into crude synthesis gas by gasification with steam and oxygen in a counter-current moving-bed reactor. The crude synthesis gas is purified and converted into pipeline quality gas (SNG) in a sequence of downstream processing units (Plant Sections 400, 500, 600, and 800). Section 300 is a one-train unit with one operating gasifier and one spare. Each gasifier is designed to process 1256 tons per day of Ohio No. 9 coal and to produce 64 million standard cubic feet per day of crude synthesis gas. The crude gas from the gasifier is quenched in a scrubber to cool the gas and remove tar and particulate matter. It then passes through a waste heat boiler and four heat exchangers to cool the gas to 95°F and to condense gas liquor and liquid hydrocarbons which are removed from the gas stream and subsequently recovered as by-products.

29877 **(DOE/ET/13060—T3(Vol.10)) Pipeline-gas Demonstration Plant. Phase I: Demonstration Plant engineering and design. Volume 10: Plant Section 900 - Sulfur Recovery.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). [nd]. Contract AC01-77ET13060. 69p. (FE—2542-38(Vol.10)). NTIS, PC A04/MF A01. Order Number DE81025784.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to be completed in June 1981. One of the major efforts of Phase I is the process and project engineering design of the Demonstration Plant. The design has been completed and is being reported in 24 volumes. This is Volume 10 which covers the design of Plant Section 900 - Sulfur Recovery. The Sulfur Recovery unit produces sulfur from gaseous streams discharged from Plant Sections 400, 1100, and 1300 using a modified Beavon Sulfur Removal Process. This process consists of a Stretford system containing two Stretford absorbers and a hydrogenation section. The gaseous discharge from the Sulfur Recovery unit is an environmentally acceptable vent containing approximately 300 ppM SO_2. The Sulfur Recovery unit is designed to produce a maximum anticipated sulfur output of approximately 53 long tons per day.

29878 **(DOE/ET/13060—T3(Vol.14)) Pipeline-gas Demonstration Plant. Phase I: Demonstration Plant engineering and design. Volume 14: Plant Section 1300 - Ammonia Recovery.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). [nd]. Contract AC01-77ET13060. 37p. (FE—2542-38(Vol.14)). NTIS, PC A03/MF A01. Order Number DE81028441.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to

be completed in June 1981. One of the major efforts of Phase I is the process and project engineering design of the Demonstration Plant. The design has been completed and is being reported in 24 volumes. This is Volume 14 which covers the design of Plant Section 1300 - Ammonia Recovery. The purpose of the Ammonia Recovery unit is to remove ammonia and acid gases from the gas liquor stream from the Phenol Extraction unit. The ammonia and acid gases are detrimental to the operation of the waste water treatment system. The PHOSAM-W Process is used to remove the ammonia and acid gases from the gas liquor to produce a saleable anhydrous ammonia produce and an acid gas stream which is processed in Plant Section 900 - Sulfur Recovery. The Ammonia Recovery unit is designed to produce 717 pounds per hour of ammonia contained in 32,084 pounds per hour of gas liquor.

29879 **(DOE/ET/13060—T3(Vol.19)) Pipeline-gas Demonstration Plant. Phase I: Demonstration Plant engineering and design. Volume 19: Plant Section 3000 - Flare.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). [nd]. Contract AC01-77ET13060. 94p. (FE—2542-38(Vol.19)). NTIS, PC A05/MF A01. Order Number DE81028343.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to be completed in June 1981. One of the major efforts of Phase I is the process and project engineering design of the Demonstration Plant. The design has been completed and is being reported in 24 volumes. This is Volume 19 which reports the design of Plant Section 3000 - Flare. The purpose of the flare is to burn combustible streams that are vented from equipment during emergency, start-up, or other abnormal situations. The Demonstration Plant is equipped with one flare. There are two flare header systems in the plant; the high pressure header and the low pressure header. Each header is continually purged with nitrogen to prevent the accumulation of combustible mixtures. Relief valve discharges flow through the header to a knockout drum where entrained liquids are separated and recovered. Vapors flow up the flare stack and are combusted at the flare tip. Fuel gas is continually sent to the flare tip to maintain a pilot light. Steam and air injected into the tip provide smokeless operation.

29880 **(DOE/ET/13060—T3(Vol.21)) Pipeline-gas Demonstration Plant. Phase I: Demonstration Plant engineering and design. Volume 21: Plant Section 3300 - County Road.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). [nd]. Contract AC01-77ET13060. 91p. (FE—2542-38(Vol.21)). NTIS, PC A05/MF A01. Order Number DE81028439.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the US Department of Energy provides for the design, construction, and operation of a demonstration plant capable of processing bituminous caking coals into clean pipeline quality gas. The project is currently in the design phase (Phase I). This phase is scheduled to be completed in June 1981. One of the major efforts of Phase I is the process and project engineering design of the Demonstration Plant. The design has been completed and is being reported in 24 volumes. This is Volume 21 which reports the design of Plant Section 3300 - County Road. In order to provide adequate access to the Demonstration Plant site during construction and operation, some road building and upgrading of existing roads are necessary. The access to the southern portion of the plant site is provided by County Road 6 from State Road 78. State Road 78 is of sufficient quality to accommodate heavy truck traffic. However, County Road 6 will have to be upgraded for approximately four miles, from East Union to the southern edge of the plant site. From County Road 6 at the southern edge of the site, a new road will be constructed through the plant site to State Road 146. This will provide two possible access routes to the Demonstration Plant. The design of the new road and the design of the upgraded county road are presented in this volume.

29881 **(DOE/ET/13060—T11) Pipeline-gas Demonstration Plant. Phase I: Economic Reassessment.** (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). [nd]. Contract AC01-77ET13060. 114p. (FE—2542-44). NTIS, PC A06/MF A01. Order Number DE81029066.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the United States Department of Energy (DOE) provides for Conoco Inc. to design, construct, and operate a Demonstration Plant capable of converting high-sulfur bituminous caking coal to a high-Bt pipeline quality gas. One of the assignments under the contract is the preparation of an economic reassessment of the Demonstration Plant and a Commercial Plant. This report covers an economic analysis of both the Demonstration and Commercial Plants based on the definitive estimate of the Demonstration Plant. Economics of the Demonstration Plant and Commercial Plant are evaluated using a DCF (Discounted Cash Flow) method. Five base case evaluations are provided for each plant. A sensitivity analysis showing the variation in product gas price with changes in the major components of the price is presented for two of the cases. Gas prices for the Demonstration Plant range between $17.46 and $32.36 per million Btu of product gas while gas prices for the Commercial Plant vary from $4.85 to $8.91 per million Btu of product gas.

29882 **(DOE/ET/13060—T12) Pipeline-gas Demonstration Plant. Phase I: Demonstration Plant recommendations report.** DiFulgentiz, R.A. (Conoco, Inc., Stamford, CT (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). [nd]. Contract AC01-77ET13060. 61p. (FE—2542-29). NTIS, PC A04/MF A01. Order Number DE81028436.

Contract No. EF-77-C-01-2542 between Conoco Inc. and the United States Department of Energy provides for the design, construction, and operation of a Demonstration Plant capable of converting eastern US bituminous caking coals into clean pipeline quality gas using British Gas/Lurgi slagging gasifiers. The main purpose of the project is to demonstrate technology which can produce clean fuels from coal in a safe, reliable, and economically and environmentally acceptable manner. The conceptual design of the Commercial Plant (Task I), the process design of the Demonstration Plant (Task II), the site plans and reports (Task III), and the process trade-off studies (Task XII) were reexamined as a group to reassess the process and size selected for the Demonstration Plant. This reassessment considered the economic, environmental, and technical aspects of the Demonstration Plant. The conclusions of this reassessment are presented in this report. The overall conclusion is that no changes in the process design or size of the Demonstration Plant, as presented in Report No. FE-2542-28, are needed to meet the objectives of the Demonstration Plant program. The data obtained from the Demonstration Plant will fully ascertain the economic, environmental, and technical performance of future commercial plants.

0105 By-products

REFER ALSO TO CITATION(S) 30100, 30101

29883 **Utilization of fluidized bed combustion by-products in aerated concrete.** Slonaker, J.F. (WVa Univ, Morgantown). *West Virginia University Coal Research Bureau Technical Report ;* No. 175, vp(Dec 1979).

The utilization potential of fluidized bed combustion by-products in aerated concrete is discussed in this report. The by-products investigated in this report were obtained from the Pope, Evans and Robbins fluidized bed combustion process at Rivesville, West Virginia.

0106 Properties

REFER ALSO TO CITATION(S) 29780, 29796, 29799, 29801, 29802, 29808, 29834, 29849, 29858, 29860, 29870, 29895, 29900, 30534, 30785

29884 (DOE/MC/08333—167, pp 327-346) **Fundamental studies of physico-chemical properties of coal slags.** Elliott, J.F. (Massachusetts Inst. of Tech., Cambridge). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The work of the past year has involved three activities. The first has been an effort to model the thermodynamic behavior of components in liquid oxides that are typical of coal slags. A new method of analysis has been under development which, when completed, may provide an improved method of obtaining information from ternary and higher-order phase diagrams. An application of the method is included here. The second activity is a continuation of a study of the use of the theory of the ionic structure of slags to predict the thermodynamic behavior of components of these slags. That work is in progress, and no report on it is included here. The third activity has been the calculation of the activities of each component in the liquid field at 1050°C (1922°F) of the Na_2O-Fe_2O_3-SiO_2 system. The calculations are based on information describing the behavior of Na_2O in the system that is available from another investigation.

29885 (DOE/MC/08333—167, pp 347-361) **Laser fluorescence studies of the chemistry of sodium in flames and its interactions with fuel sulfur.** Hynes, A.J.; Steinberg, M.; Schofield, K. (Univ. of California, Santa Barbara). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The nature of sodium in oxygen-rich flames and its interactions with sulfur under both fuel-rich and lean conditions remains unsatisfactorily characterized and the identity of the predominant molecular species is not known with any certainty. Utilizing quantitative laser fluorescence measurements of the concentrations of atomic sodium, OH radicals and various sulfur species in a large matrix of $H_2/O_2/N_2$ and $C_2H_2/O_2/N_2$ flames it is hoped to be able to unravel the detailed combuston of sodium in the initial 5 ms of the burnt gases where non-equilibrium effects and the precursor chemistry occurs that can result in high temperature Na_2SO_4 corrosion problems. Thermochemical values for the predominant species will be established.

29886 (DOE/PC/30226—T1) **Characterization of western coals and coal macerals by solid state Nuclear Magnetic Resonance Spectroscopy. Progress report.** Pugmire, R.J.; Grant, D.M. (Utah Univ., Salt Lake City (USA)). 5 Aug 1981. Contract FG22-80PC30226. 60p. NTIS, PC A04/MF A01. Order Number DE81028928.

In August we will begin analytical runs on 2 to 3 bituminous coals that have been selected on the basis of petrographic analysis as having a high concentration of a given maceral (i.e., vitrinite, bituminite, fusinite, or semi-fusinite). We have secured a set of 23 western coals from the Penn State data bank to begin our initial selection and studies. We will order additional hand picked samples shortly. A new NMR spectrometer has been secured for our maceral studies. Bruker Instruments has built and delivered a CXP spectrometer according to our specifications which operates at 100 MHz (proton). This spectrometer became operational in May 1981. This instrument is devoted to solids studies and is used approximately 20% of the time on this project. Prior to the arrival of the CXP spectrometer, solid NMR data was acquired on a modified Varian XL-100 spectrometer. This instrument is now being phased out because of age and maintenance problems. In order to facilitate the beginning of our study of coal macerals, samples of interest were secured from various sources pending availability of material separated in our own laboratory.

29887 (LA—8275-PR) **Trace element characterization of coal wastes. Fourth annual progress report, October 1, 1978-September 30, 1979.** Williams, J.M.; Bertino, J.P.; Jones, M.M.; Wagner, P.; Wanek, P.L.; Wangen, L.E.; Wewerka, E.M. (Los Alamos National Lab., NM (USA)). Apr 1981. Contract W-7405-ENG-36. 169p. (EPA/600/7—81-073). NTIS, PC A08/MF A01. Order Number DE81028237.

In the past year assessment studies of low-sulfur coal wastes from the Appalachian Region have been continued. These included mineralogical and trace elemental analyses on these materials and studies of their weathering and leaching behavior. Although the concentrations of the acid-forming minerals (pyrite and marcasite) were very low, leachates were quite acid (pH $<$ 3) with concomitant trace element (Al, Mn, Fe, Ni, Cu) concentration elevation. As part of the overall assessment of the degree of environmental concern associated with acidic coal waste drainages, bioassay studies were performed. These revealed that coal wastes and their leachates are toxic to fresh water algae, fathead minnows, and one species of fresh-water flea. Laboratory experiments to identify control options for the coal wastes and their drainages have been focused on predisposal and codisposal treatments of the waste, with technical and economic evaluations being performed on the most promising options. One of the most promising control methods is pretreatment of the waste with a lime/limestone mixture; this produces a waste with no acid-forming tendencies for times up to several months, during which time it may be possible to dispose of the treated waste in a nonreactive environment. The cost of this option is comparable to that of the commonly used lime neutralization of the acid drainage. Other experiments have investigated, in considerable detail, the economic and environmental advantages and disadvantages of codisposing the wastes with 37 naturally occurring soils and industrial wastes. These methods look promising only under certain conditions, but are in general an order of magnitude less effective than existing controls or the lime/limestone disposal method.

29888 (LA—8825-PR) **Radioactive emissions from coal production and utilization. Second annual progress report, October 1, 1979-September 30, 1980.** Wagner, P.; Greiner, N.R. (Los Alamos Scientific Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01. Order Number DE81028821.

During FY 80 we analyzed a variety of coals and coal-related solids for radionuclide content, we leached a number of solids and analyzed the leachates, and we measured the emanation from a variety of coals and related solids. The purpose of these investigations is to establish a suitable data base from which to evaluate the magnitude of the radiologic hazards from coal use, and if warranted, to devise control technology to mitigate the hazards identified. Based on the limited number of samples received, our studies indicate that the coals, related solids, their leachates, and emanations present very little radioactivity of environmental concern. Most of the solid samples and their ^{222}Rn emanations pose a hazad comparable to that of ordinary soils. Some of the fly ashes may be exceptions. Two samples showed elevated ^{226}Ra, ^{210}Pb, and ^{210}Po levels in the small particle fractions. None of the leachates prepared exceeds the maximum permissible concentration (MPC) in Code of Federal Regulation (CFR)-10 for any of the ^{238}U of ^{232}Th series radionuclides; most are a few percent or less of the MPC.

29889 (ORNL/TM—7663) **Application of materials-characterization techniques to coal and coal wastes.** Lauf, R.J. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 75p. NTIS, PC A04/MF A01. Order Number DE81026087.

The purpose of the present work has been to adapt standard techniques of materials science to the problem of characterizing coal wastes. Transmission electron microscopy provided a detailed view of the microstructures of submicron fly ash particles while reflected-light microscopy provided a complementary study of larger ones. Electron microprobe analysis was helpful in relating microstructural features to chemical and mineralogical factors, and ion microprobe mass analysis produced elemental distribution maps for large inhomogeneous particles. X-ray diffraction provided a broad overview of the phases present in different ash samples so that the effect of coal mineralogy could be appreciated. Several experiments were conducted to identify the location of certain trace elements. It was found that copper, chromium, cobalt, nickel, vanadium, and cadmium appear to be associated with microscopic framboidal pyrite in the coal. After combustion, these elements are segregated in those fly ash particles representing the oxidized remains of the framboids. The distribution of lead, arsenic, molybdenum, sulfur, and possibly zinc appears to rely on volatilization in the combustion zone followed by vapor-phase transport. Thus, these elements would most likely be found at or near the surfaces of fly ash particles. However, vacuum heating experiments indicate that the current vaporization/condensation model might be an oversimplification. A model was developed to predict cenosphere formation tendencies on the basis of ash chemistry.

0108 Waste Management

REFER ALSO TO CITATION(S) 29767, 29801, 29879, 29883, 29887, 30879, 31193

29890 **(ARI-RP—66) Third quarterly technical summary report on the homogeneous production and removal of NO/sub x/ from combustion exhaust flows.** Silver, J.A. (Aerodyne Research, Inc., Bedford, MA (USA). Center for Chemical and Environmental Physics). May 1981. Contract AC21-80MC14737. 30p. NTIS, PC A03/MF A01.

The addition of ammonia to the exhaust stream of stationary combustors is a promising approach toward reducing NO/sub x/ emissions. The use of high sulfur-content fuels will produce moderate quantities of SO_2 and other sulfur-bearing compounds which may affect the effectiveness of this thermal deNO/sub x/ process. Modeling efforts indicate that the presence of SO_2 is slightly beneficial in removing NO above 1250K. In addition, experiments show that the ammonia species (NH/sub i/, i = 1,2,3) have no appreciable reaction rate with SO_2. An explanation of the effect of SO_2 on the thermal deNO/sub x/ process is presented, as well as preliminary calculations leading to the measurement of the key reaction of $H + SO_3$.

29891 (CONF-800718—, pp 141-142) **Interaction of stabilized coal waste and seawater.** Wilke, R.J. (State Univ. of New York, Stony Brook); Dayal, R. 1980. NTIS (US Sales Only), PC A10/MF A01.

From 3. international symposium on water-rock interaction; Edmonton, Alberta, Canada (14 Jul 1980).

A research program is described which is intended to determine the environmental suitability of utilizing stabilized coal wastes such as scrubber sludge and fly ash for the construction of artificial marine reefs. The compositional and structural changes in the stabilized waste as a result of exposure to seawater are examined. (ACR)

29892 **(DOE/ET/11026—T1) Simultaneous high-temperature removal of alkali and particulates in a pressurized gasification system. Final technical progress report, October 1978-October 1980.** Mulik, P.R.; Ciliberti, D.F.; Alvin, M.A.; Ahmed, M.M.; Bachovchin, D.M.; Keairns, D.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Feb 1981. Contract AC21-78ET11026. 183p. (FE—3245-23). NTIS, PC A09/MF A01. Order Number DE81025901.

This final project report summarizes the results of extensive thermodynamic and preliminary experimental studies that have identified the use of aluminosilicate materials for simultaneously removing volatile alkali and particulate released during pressurized gasification of coal. The gettering capacity of three selected materials has been evaluated in a bench-scale reactor operating at 1114 kPa total pressure and 1123 to 1173 K in alkali-laden inert and simulated fuel gas environments. At 1123 K alkali gettering results through insoluble complexes, while at 1173 K saturation of the insoluble complex is completed, with gettering occurring mainly through soluble complexes. The gettering mechanism will be delineated through future thermogravimetric studies in a proposed program extension.

29893 (DOE/MC/08333—167, pp 301-326) **Surface enrichment of aluminosilicate minerals and coal combustion ash particles.** Stinespring, C.D.; Stewart, G.W. (Morgantown Energy Technology Center, WV). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

Auger electron spectroscopy has been used to provide evidence of surface segregation in illite, an aluminosilicate mineral representative of those which produce coal combustion ash particles. For the temperature range of 150 to 1100°C, the segregation of Fe, K, Ca, and S has been observed, and the temperature dependence of the segregation levels of these elements has been determined. A comparison of these results with the reported data for surface enrichment of coal combustion as particles indicates that the segregation levels of Fe, K, Ca, and S in heated illite are comparable to the levels observed for the ash particles. Order-of-magnitude calculations indicate that appreciable segregation may occur on a time scale compatible with the residence time of ash particles in the combustor. These results are particularly significant because the surface enrichment of coal combustion ash has been generally attributed solely to adsorption/condensation processes. Thus, the conclusion of this work is that the surface composition of coal combustion ash particles will be determined by a number of physical-chemical processes including segregation, adsorption/condensation, desorption/evaporation, and gas-surface reactions which may occur on the surface of the ash particle. A complete understanding of the surface composition of the ash will, therefore, require a knowledge of the thermodynamic and kinetic parameters for these processes.

29894 **(DOE/PC/30296—T1) Advanced pulverized-coal combustor for control of NO/sub x/ emissions. Third quarterly report, April 1-June 30, 1981.** Pam, R.L.; Suttmann, S.T.; Kelly, J.T.; Chu, E.K. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). 31 Jul 1981. Contract AC22-80PC30296. 20p. NTIS, PC A02/MF A01. Order Number DE81029124.

The program uses an idealized one-dimensional combustor, incorporating fuel staging. A comprehensive computer model is being developed under the program to allow NO mechanisms and rates to be extracted from the experimental data. During the quarter, initial PROF code runs led to extensive debugging efforts. A simplified radiation model formulation and devolatilization model are also described. Combustor installation was completed and shakedown begun. Full-scale work in Japan utilizing fuel staging concepts is summarized in terms of its NO/sub x/ reduction potential.

29895 **(EGN—96) Coal fly ash: a review of the literature and proposed classification system with emphasis on environental impacts.** Roy, W.R.; Thiery, R.G.; Schuller, R.M.; Suloway, J.J. (Illinois State Geological Survey, Urbana (USA)). Apr 1981. 69p. NTIS, PC A04/MF A01.

This comprehensive review of the scientific literature on fly ash generated by coal burning power plants cites studies reported in 284 publications up to September 1980. General conclusions are formulated, on the basis of data compiled from this review, on the physico-chemical characteristics of the solid waste and the possible environmental impacts of its disposal. Fly ash is composed of fine-grained particles that have a variable morphology and consist primarily of an amorphous glassy material. The elemental composition of fly ash is highly variable and directly related to compositional variations in the parent coals and to the operational characteristics of the individual power plants. Some elements are concentrated (enriched) on fly ash particle surfaces. While the glass-like particles are essentially insoluble in water, the enriched surface elements may be soluble and therefore available to the environment upon leaching of the solid waste. Fly ash leachates also demonstrate a great deal of variability in chemical composition. Toxicity studies suggest that fly ash leachates may adversely effect aquatic ecosystems, while the solid material may be hazardous to terrestrial ecosystems by direct external reactions (skin, eyes, etc.) or reactions in the respiratory tract or alimentary canal. The predominant method of fly ash disposal is by wet sluicing to on-site ash ponds. The greatest use of the solid waste is as an additive to concrete mixture; several other schemes for using the solid waste have been proposed. Plants grown experimental fly ash amended soils have shown enrichment of certain chemical constituents in plant tissues. A classification system for fly ash is proposed in this paper; this system should aid in systematic fly ash research and in the discussion of fly ash properties.

29896 **(EPRI-CS—1885) Study of gypsum crystal nucleation and growth rates in simulated flue gas desulfurization liquors. Final report.** Randolph, A.D.; Etherton, D. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering). Jun 1981. 69p. NTIS, PC A04/MF A01. Order Number DE81903782.

The kinetics of gypsum crystal nucleation and growth rates were measured in flue gas desulfurization (FGD) scrubber liquors. Variables studied were parent seed crystal size and mass; the organic additives citric acid, adipic acid, sodium dodecylbenzene sulfonate, and Calgon CL246 polyacrylic acid formulation; and pH. Citric

acid produced gypsum crystals with a more favorable columnar structure. Lower pH resulted in increased nucleation rates. Stable secondary nucleation was observed in the presence of retained parent gypsum seed crystals of size >150 μm. Growth and nucleation rates were correlated using reaction kinetic models. These kinetics were then used in rigorous computer simulations to predict crystal-size distribution (CSD) with different scrubber configurations. Scrubber process configurations employing classified product removal were calculated to produce a gypsum sludge having a mean particle size up to twice as large as the particle size with unclassified operation.

29897 **(EPRI-EA—1886) Biocide usage and ash-handling practices at selected operating steam electric plants. Final report.** Bergesen, C.A.E. (Atomic Industrial Forum, Inc., Washington, DC (USA)). Jun 1981. 90p. NTIS, PC A05/MF A01. Order Number DE81903740.

The objective of the project was to expand the Atomic Industrial Forum (AIF) POWER data base to include subsets containing state-of-the-practive information on biocide usage and ash handling systems at steam-electric generating plants in the United States. The work by AIF involved obtaining documents and data on all operating or planned units, confirming the data, and building specific POWER data base subsets on biocides and ash. This report contains a description of the POWER data base with emphasis on summarizing the contents of the subsets containing biocides and ash information. Tables have been prepared to indicate what types of data are not present in the data base for power plants exceeding a capacity of 100 MWe.

29898 **(LA-UR—81-1904) Environmental control technology for coal cleaning wastes.** Wagner, P.; Heaton, R.C.; Wangen, L.E.; Nyitray, A.M.; Jones, M.M. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 20p. (CONF-8106109—1). NTIS, PC A02/MF A01. Order Number DE81025331.

From Workshop on processing needs and methodology for wastewaters from the conversion of coal, oil shale and biomass to synfuels; Germantown, MD, USA (Jun 1981).

Chemical and mineralogical examination of coal wastes and their drainages has led us to consider three approaches to solution of the coal waste drainage problem. The first is alteration of the waste to render it non-polluting. Calcining of the waste has been shown to be an effective way of accomplishing this, but the cost of this technique is too high for it to be of any use. The second approach is codisposal of the coal waste with neutralizing and/or absorbing agents. The best way to implementing this approach is sequential slurry coating of the coal waste with lime and limestone, which is both effective and inexpensive. This is probably the best of the one-time treatments which we have evaluated when both effectiveness and cost are considered. Unfortunately this approach suffers from a lack of permanence and must be augmented with some other method of permanent diposal. The third approach to controlling coal waste effluent is to collect and treat the drainages. Perhaps the most effective way of doing this is by alkaline neutralization of the drainages. This is currently the most widely used technique for this purpose, because of its simplicity and availability. We have shown that it is effective provided that the iron is oxidized to the plus three oxidation state, and that the cost of this treatment is low. However, the need for continued treatment into the indefinite future must be considered a severe limitation.

29899 **(PB—81-801110) Coal mine waste. 1964-November 1980 (citations from the NTIS data base). Report for 1964-November 1980.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1980. 233p. NTIS PC N01/MF N01.

Research topics cover coal mining refuse, refuse dumps, and spoil. Studies on disposal, utilization, environmental impacts, and testing of these wastes are included, as are reports on land reclamation and spoil bank safety. (This updated bibliography contains 224 citations, 29 of which are new entries to the previous edition.)

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 29769, 29778, 29792, 29793, 29797, 29798, 29800, 29802, 29804, 29805, 29806, 29814, 29817, 29887, 30483, 31195, 31295

0110 Reserves And Exploration

29900 **(DOE/ET/14693—T2) Peat deposits of Croatan Forest Craven, Jones, and Carteret Counties, North Carolina.** Ingram, R.L.; Otte, L.J. (North Carolina Univ., Chapel Hill (USA). Dept. of Geology; Kent State Univ., OH (USA)). Jun 1981. Contract AC01-79ET14693. 24p. NTIS, PC A02/MF A01. Order Number DE81028600.

The Croatan Forest peats are located about 15 miles south of New Bern, North Carolina, in 5 separate deposits in southwestern Craven County and adjoining parts of Jones and Carteret counties. Except for some channels where the peat may be 6 to 10 ft thick, the peat lies in broad shallow depressions and increases in thickness from 0 ft at the margins to about 6 ft in the interior of the deposits. The deposits occupy an area of 35,000 acres (55 sq mi) containing about 27 million tons of moisture-free peat. The deposits greater than 4 ft thick occupy an area of 11,500 acres containing about 14 million tons of peat. Surface elevations of the peat range from about 40 ft in the northwest to about 30 ft in the southeast. Two main types of peat are present: (1) a brown, decomposed fibrous peat usually found at the base of the thicker peats, and (2) a black, fine-grained, highly decomposed humic peat that usually overlies the fibrous peat. The moisture content ranges from 65 to 95% with an average of 82% and usually increases with depth and with increasing total thickness of peat. Away from the margins and bottoms of the deposits, the ash content is usually less than 5%. Heating values for the low ash peats range from 8900 to 11,000 Btu/lb with a median of 10,300. The sulfur content ranges from 0.1 to 0.3% with a median of 0.2%.

0120 Mining

REFER ALSO TO CITATION(S) 29777, 29933, 31067

29901 (CONF-800716—, pp VIII.1-VIII.5) **Drilling horizontal holes in coal with water jets.** Timmerman, M. (Sandia National Labs., Albuquerque, NM); Barker, C.R. 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Holes drilled horizontally into coal beds from a vertical hole can be used to drain methane from gassy coal prior to mining and to link vertical wells for underground coal gasification. A device using high pressure water jets to drill those holes is being developed by Sandia National Laboratories. The drilling head is lowered down a vertical hole on an articulated drill string, rotated to the horizontal at the coal seam and advanced into the coal. Instruments in the drill string provide hole pitch and azimuth data to the driller on the surface. An additional system, using natural gamma detectors, radar or sonar techniques, is being developed to locate the drilling head relative to the roof and floor of the coal seam while drilling. A pitch control on the drilling head, operable from the surface, enables the driller to use this information to control drilling direction and keep the hole in the coal. First prototypes of the drilling head and the rotation mechanism have been built and tested. Holes with diameters between six and eight inches have been drilled at rates of one to two feet per minute for distances up to 35 feet. Continuing development work is described.

29902 **(DOE/ET/11268—T1) Preliminary feasibility study of tandem dragline/BWE mining approach. Final report.** (Skelly and Loy, Harrisburg, PA (USA)). Aug 1981. Contract AC01-79ET11268. 127p. NTIS, PC A07/MF A01. Order Number DE81029076.

This study has acted as a catalyst to improve the understanding of past BWE practices, and to investigate the application of utilizing draglines and BWEs working in tandem. Due to the BWE's design and nature of operating, it is considered to be the fastest system for delivering overburden materials from the digging face to

its final reclamation areas. Because of the extreme size of the in-pit BWEs and other inherent problems, their development has remained relatively stagnate. Research should be directed towards effective utilization of the smaller but equally productive benchtype wheels. This type of BWE, because of its size, demonstrates better mobility in addition to withstanding shock leading when rocks or boulders are encountered; also, by being out of the active pit its production is not hampered due to the major stripping unit being down or vice versa. This smaller BWE, when coupled with a form of cross pit conveyance system should prove to be very effective working in tandem with a dragline. Further research should also be directed toward the application of BWEs into other coal producing areas of the country, especially the lignite coalfield of the southwest. The overburden geology of this region is characterized by massive amounts of virtually rock-free unconsolidated materials which are conducive to BWE's applications. Research should be undertaken to establish a simple yet accurate field method for determining overburden characteristics. This is by far the most critical of the variables to be considered. From this determination, cutting resistance factors can be applied and an analysis made of the volume of material compatible with current BWE design.

29903 **(DOE/PC/42255—2) Professional technical support services for the Mining Equipment Test Facility. First quarterly technical progress report, April 14-June 30, 1981.** Garson, R.C. (Pittsburgh Univ., PA (USA)). Jul 1981. Contract AC22-810C42255. 15p. NTIS, PC A02/MF A01. Order Number DE81025484.

The Department of Energy recently began the operation of its Mining Equipment Test Facility. One component at that facility is the highly sophisticated Mine Roof Simulator (MRS) for research and development of roof support equipment. Because of its previous experience, the University of Pittsburgh was contracted to assist the Facilities Manager by providing professional technical support services, principally for the MRS. This technical progress report briefly describes the services provided during the reporting period and planned for the next period. No significant technical disclosures of interest to those not associated with the MRS are contained herein.

29904 **(EGN—90) Hydrogeologic aspects of coal mining in Illinois: an overview.** Cartwright, K.; Hunt, C.S. (Illinois Inst. of Natural Resources, Champaign (USA). State Geological Survey Div.). Jan 1981. 19p. Illinois State Geological Survey Division, Champaign, IL. Order Number DE81903624.

Water has generally not been a significant problem in Illinois mining, although most Illinois coal mines (both surface and underground) lie partly or completely below the water table. Water-related problems in and around mines are likely to increase as it becomes economically feasible to open or expand surface mines in areas with thicker and more permeable overburden and to place underground mines at greater depths. Detailed study of the hydrogeology of mining areas before, during, and after mining can help prevent problems that may occur. Such analysis should include: (1) a study of the topography of the land surface and patterns of surface flow (especially for surface mines); (2) the identification and characterization of aquifers in the glacial drift and in the bedrock; (3) an estimate of the effects of surface or ground water flow on mining; and (4) an evaluation of the effects of mining on surface streams and on aquifers. With this information mines can be designed to be productive, efficient, and environmentally sound.

29905 **(PB—81-125262) Evaluation of fluorescent lighting systems in various underground coal mines. Final report, May 1975-June 1978.** Ketler, A.E. (OCENCO, Inc., Blairsville, PA (USA)). May 1979. Contract H0252058. 110p. NTIS, PC A06/MF A01.

This report describes a variety of coal mining lighting projects that were funded by the Bureau of Mines to obtain underground lighting experience in support of new lighting requirements for underground coal mines. Some of the variables covered were low and high coal, narrow and wide entries, conventional and continuous mining, ac and dc power, bituminous and anthracite coal, machine mounting, and area lighting.

29906 **Future of small scale mining.** Meyer, R.F.; Carman, J.S. (eds.). New York, NY; McGraw Hill (1978). 524p. (CONF-7811184—).

From 1. international conference on the future of small-scale mining; Queretaro, Mexico (27 Nov 1978).

The first international conference on the future of small scale mining was sponsored by The United Nations Institute for Training and Research (UNITAR) and The Consejo de Recursos Minerales and Secretaria de Patrimonio y Fomento Industrial (SEPAFIN) of the Government of Mexico and held 26 November-5 December 1978, at Jurica, Queretaro, Mexico. Six papers have been entered individually into EDB. The papers mainly concern small metal mining operations and only those concerning coal, uranium, and oil shales have been entered. (LTN)

0130 Transport And Handling

REFER ALSO TO CITATION(S) 29843, 29898

29907 (CONF-800716—, pp VI.1-VI.12) **Methanol from UCG for methanol-coal slurry transportation system.** Deepak, K.; Coghill, D.R.; Bonnell, R.W. (Cities Service Co., Tulsa, OK). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Surface mineable coals extend to 60 meters (200 feet) below the earth surface and coals amenable for UCG lie between 60 meters (200 feet) and 915 meters (3000 feet) below the surface. A conceptual process scheme is presented which delivers energy from both of these coal resources. The gas produced by UCG requires a mine mouth user for economic reasons. Converting this gas to methanol, which can then be used as a transporting medium for surface mineable coal, resolves this problem. Preliminary economics of producing methanol from gas obtained via UCG are included. Coal/water slurry pipelines, currently in operation in the US, transport a small fraction of the domestic coal production. However, the slurry pipeline network will increase as the demand for coal expands. The transportation of water from western states faces political opposition. Production of methanol to replace water as the transporting medium would provide additional local economic growth, eliminate the stigma of interstate water transportation and prove to be politically preferable. Methanol has significant advantages over water as a slurry medium. Most importantly, the methanol has value as a fuel, eliminating the necessity for coal/slurry separation and greatly increasing the net delivered energy. Coal seams deeper than 60 meters (200 feet) are not suitable for strip mining and are excellent candidates for in-situ gasification to produce synthesis gas. Subsequent conversion to methanol can be accomplished with commercial technology and is economically competitive with methanol from traditional feedstocks. In this manner, the regional coal resource (both mineable and unmineable) can be more adequately utilized.

29908 **(CONF-810814—6) Selective separation of coal feedstocks for conversion by magnetic separation techniques.** Hise, E.C.; Holman, A.S. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01. Order Number DE81028060.

From 91. national meeting of the American Institute of Chemical Engineers; Detroit, MI, USA (16 Aug 1981).

The Open-Gradient Magnetic Separation (OGMS) technique can separate particles on the basis of small differences in magnetic susceptibility. The highly reactive coal macerals are diamagnetic while the minerals and less reactive macerals range from slightly diamagnetic to paramagnetic with the pyritic minerals exhibiting the greatest positive magnetic susceptibility. OGMS can spread a falling stream of fine coal into a spectrum permitting the physical separation of these several maceral and mineral groups. Several eastern bituminous coals have been selectively separated into five to ten fractions. Petrographic examination of these separated fractions shows a concentration of the maceral and mineral groups in the appropriate fractions. It is proposed that the selective separation of the most reactive macerals, as well as of those minerals that exhibit a catalytic effect, can enhance the efficiency of coal conversion.

29909 (DOE/MC/14266—T7) Coal materials handling - classifier evaluation. Quarterly progress report, April - June 1981. Rogers, R.S.C. (Kennedy Van Saun Corp., Danville, PA (USA)). 1981. Contract AC21-80MC14266. 25p. NTIS, PC A02/MF A01. Order Number DE81026439.

This is the third and final Quarterly Progress Report for DOE Contract No. DE-AC21-80MC14266, Coal Materials Handling - Classifier Evaluation. It covers the period 1 April - 30 June 1981. The project is divided into seven tasks which are grouped into three general phases of work: Preparation Phase, Testing and Data Reduction Phase and Reporting Phase. The following summarizes progress made during the present quarter. Under the Preparation Phase, the final shipment of study coal has been delivered to KVS and the vari-mech classifier has been modified for testing. The sizing and data analysis methodologies have been revised. The revised methodologies have been described and demonstrated. Under the Testing and Reduction Phase, 15 shakedown tests and 39 of the 96 tests described in the PROGRAM PLAN MANUAL have been completed to date. Additional tests of the centrifugal classifier using a third circuit feed size and coals of relatively high and low moisture have also been conducted. Size selectivity functions have been determined for the majority of tests performed to date.

29910 (DOE/MC/14266—T8) Coal materials handling: classifier evaluation. Quarterly progress report, January-March 1981. Rogers, R.S.C. (Kennedy Van Saun Corp., Danville, PA (USA)). 1981. Contract AC21-80MC14266. 22p. NTIS, PC A02/MF A01. Order Number DE81029285.

The centrifugal classifier and ductwork have been fabricated and installed in the KVS Test Facility. The Program Plan has been reviewed and approved by the DOE Technical Project Officer. The sizing procedures and data analysis methodology have been derived, developed and experimentally verified. Under the Testing and Data Reduction Phase, shakedown testing of the centrifugal classifier in closed circuit with the air-swept ball mill has been successfully completed. The open circuit testing of the centrifugal classifier has also been completed and the analysis of data from this testing is underway. This completes roughly one-third of this phase of the project work.

29911 (DOE/MC/14603—T6) Progress report for July 1981. (Conspray Construction Systems, Inc., Santa Ana, CA (USA)). 1981. Contract AC21-80MC14603. 4p. NTIS, PC A02/MF A01. Order Number DE81028918.

29912 (EPRI-CS—1880) Control systems in coal-preparation plants. Final report. Wells, C.H. (Envirotech Corp., Palo Alto, CA (USA). Envirotech Measurement Systems Div.). Jun 1981. 130p. NTIS, PC A07/MF A01. Order Number DE81903784.

This report for RP1338-1 presents the results of a preliminary assessment of control systems in coal preparation plants. This is Phase I of a project dealing with US coal-cleaning instrumentation and automation. During this project phase, 12 coal-cleaning plants were investigated to determine current instrumentation and control practices. At each plant, the plant manager and operators were interviewed, and four coal-cleaning plant design firms were surveyed to determine their attitudes toward new and improved coal-cleaning instrumentation and control systems. General findings of the project are that instrumentation in current coal-cleaning plants is relatively primitive and that often even the most basic operations, such as fluid levels and cleaning media gravities, are not automatically controlled. Even when control instrumentation is installed, it is not adequately maintained. The report concludes that the lack of control systems in coal-cleaning plants is attributable to a lack of economic incentives due to past low coal prices and to the fact that reliable instrumentation has generally not been available. The Continuous On-line Nuclear Analyzer of Coal (CONAC), developed under RP983, could help to alleviate this situation by providing on-line measurements on a real-time basis. The report details possible uses of instrumentation and controls in all phases of coal cleaning, from feed control to automated operation of unit processes. It also discusses possible economic gains that could result from tighter product quality control and consequent higher clean-coal yields.

29913 (EPRI-WS—80-141, pp 14.1-14.15) Prospect for economically processed clean coal. Ehrlich, S. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

Coal cleaning is an old art that exploits straightforward differences between coal matter and ash-forming minerals. Liberation is always the first step; here the minerals are broken loose from the coal structure. Separation is then the next step in which the low density of coal and/or its hydrophobicity are used to separate coal from ash. The cost and complications arise because fine coal and coarse coal must be treated separately and because some particles contain both coal and ash. This paper will explain the basic principles by way of a set of graphics. The important tradeoffs between capital investment, recovery of coal (or loss of BTu's to waste) and effectiveness of cleaning (reduction of ash and sulfur) are explained.

0140 Combustion

REFER ALSO TO CITATION(S) 29834, 29894, 30477, 30478, 30479, 30482, 30483, 30484, 30485, 30486, 30488, 30489, 30502, 30503, 30504, 30505, 30506, 30507, 30509, 30510, 30512, 30513, 30515, 30516, 30517, 30518, 30519, 30520, 30521, 30522, 30523, 30524, 30525, 30526, 30528, 30530, 30531, 31116, 31117

29914 (CONF-800716—, pp VIII.48-VIII.64) In situ complete coal combustion for power generation. Maslan, F. (KETRON, Inc., Rosslyn, VA). 1980. NTIS, PC A99/MF A01.

From 6. underground coal conversion symposium; Afton, OK, USA (13 Jul 1980).

Complete underground coal combustion (UCC) with air followed by surface conversion of the sensible heat of the gases to electricity offers a developing technology for utilizing much of the coal resource, both bituminous and subbituminous. Several UCC systems were conceptually designed and analyzed. The economics and environmental consequences of these systems when compared with alternate methods for generating electricity show significant advantages in cost and low environmental impacts. Analysis indicates that complete in situ combustion is economically competitive, especially in small plant sizes, and is a worthwhile partner technology to underground coal gasification in all parts of the country. In this study, concepts for the use of small decentralized underground coal combustion plants have been proposed. The economics of these plants, both capital and operating, are favorable, with operating costs of 22 to 33 miles per kilo-watt-hour. This idea of utilizing UCC for decentralized small power plants capable of exploiting selected coal resources is an important new concept. Comparison of UCC economics with that of other proposed alternative methods for the manufacturer of electricity shows that it is either competitive or cheaper.

29915 (DOE/ET/10686—T1) Formation and control of fuel-nitrogen pollutants in catalytic combustion of coal-derived gases. Final report. Walsh, P.M.; Bruno, C.; Santavicca, D.A.; Bracco, F.V. (Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering). 1 Feb 1980. Contract AS21-77ET10686. 140p. (FE—2762-9). NTIS, PC A07/MF A01. Order Number DE81025534.

The objective of this program has been the elucidation of the mechanism of high temperature catalytic oxidation of coal-derived gases, including their individual constituents,and the effects of sulfur and nitrogen impurities. Detailed experimental data were obtained and a two-dimensional model is being developed and tested by comparison with the experimental data. When complete, the model can be used to optimize designs of catalytic combustors. The model at present includes axial and radial diffusion and gas and surface chemical reactions. Measured substrate temperatures are input in lieu of complete coupling of gas and solid energy conservation equations and radiative heat transfer. Axial and radial gas temperature and composition profiles inside a catalyst channel were computed and compared with experimental measurements at the catalyst outlet. Experimental investigations were made of carbon monoxide and medium-Btu gas combustion in the presence of platinum supported on a monolithic Cordierite substrate. Axial profiles of substrate temperature, gas temperature, and gas composition were determined at different gas velocities and equivalence ratios. The

effects of H_2S and NH_3 in the medium-Btu gas were also investigated. Systems were proposed for making resonance absorption and Raman scattering measurements of gas temperature and/or species concentrations in a catalytic reactor. A new pulsed multipass Raman scattering technique for increasing photon yield from a scattering volume was developed.

29916 **(DOE/MC/08333—167) Proceedings: high-temperature, high-pressure particulate and alkali control in coal-combustion process streams.** (Science Applications, Inc., McLean, VA (USA)). 1981. Contract AM21-78MC08333. 697p. (CONF-810249—). NTIS, PC A99/MF A01. Order Number DE81026317.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

This document contains papers presented at the Department of Energy's Contractor Review Meeting on High Temperature, High Pressure Process Particulate and Alkali Control in Coal Combustion Process Streams. It was sponsored by the Morgantown Energy Technology Center and was held in Morgantown, West Virginia on February 3-5, 1981. The purpose of the meeting was to provide a forum for the exchange of information based on presentations reflecting recent progress in the technology development, device and instrumentation testing. The initial sessions focused on where PFBC power systems are, where they are going, and the role cleanup technology does and will play so as to place the work in perspective. In addition, the most recent large-scale PFBC work was reviewed to establish the current level of development for PFBC in general and the cleanup technology in particular. The problems involved in alkali formation and control were also assessed. Forty-one papers have been entered individually into EDB and ERA. (LTN)

29917 (DOE/MC/08333—167, pp 21-26) **IEA Grimethorpe Project.** Byam, J. (Dept. of Energy, Morgantown, WV). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The Grimethorpe IEA Project, an experimental pressurized fluidized-bed combustor system built and operating as an extension to the National Coal Board Power Station adjacent to Grimethorpe Colliery, Yorkshire, England, is summarized.

29918 (DOE/MC/08333—167, pp 234-241) **Data base and experimental studies of gas phase alkali ... SO_2 interactions.** Abramowitz, S.; Herron, J.T.; Tsang, W. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

Thermodynamic and kinetic activities at NBS in support of the METC program on hot gas clean-up will be reviewed. Present and future data compilations, and evaluations as well as experimental efforts will be described. With respect to the former the need and the strategy for generating a chemical transformation data base is developed. Experimental work will involve the application of mass spectroscopic and matrix isolation techniques for the detection and identification of reaction intermediates and products, as well as the determination of kinetic and thermodynamic properties.

29919 (DOE/MC/08333—167, pp 275-300) **Reactions of alkali containing species in combustion streams.** Stewart, G.W. (Aerodyne Research, Inc., Bedford, MA); Chakrabarti, A.; Moore, W.R. 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The effect of alkali in coal combustion streams has received increased attention because of interest in combined cycle processes. In this paper, we discuss recent studies which describe alkali release during the pyrolysis of model organic molecules. The pyrolysis of sodium and potassium benzoate in an inert atmosphere show the release of condensed ring organic molecules below 500°C with the alkali remaining in the condensed phase as an alkali carbonate and/or oxide. At temperatures above 700°C in a gas stream containing CO_2, the alkali carbonate catalytically removes carbonaceous material producing CO. In the presence of SO_2 and O_2, the alkali carbonate is converted to the alkali sulfate. Only above the decomposition temperature of the alkali intermediate is any gaseous alkali species observed. Kinetic parameters for the release of the organic species, as well as the decomposition of the alkali carbonate intermediate product, have been obtained. The implications of the results of these studies on the removal and/or control of alkali in combined cycle process streams is discussed.

29920 **(DOE/METC/RI—178) Combustion of western coal in a fluidized bed.** Abel, W.T.; Rice, R.L.; Shang, J.Y.; Turek, D.G.; Ayers, W.J. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Jul 1981. 32p. NTIS, PC A03/MF A01. Order Number DE81028103.

Subbituminous coals amount to over 25% of the National's coal reserves and are located in dry areas. Fluidized-bed combustion (FBC) offers a clean stack gas without additional water requirement. A western subituminous coal from the Rosebud mine in Montana was burned in the 18-inch diameter FBC unit at the Morgantown Energy Technology Center (METC) to investigate its potential as an FBC fuel. In this study, bed temperature ranged from about 1450 to 1670°F and fluidizing air velocity ranged from 2.6 to 4 t per second. The investigation included operating characteristics, SO_2 emission with and without added limestone, distribution of solids and solid components throughout the system; other pertinent data are reported. Sulfur retention was greatest at lower bed temperatures (1450°F). It was concluded that: sulfur dioxide emisson can be kept below the EPA limit of 1.2 lb/10^6 Btu without any added sorbent for bed temperatures below 1500°F; more stringent limits may require the addition of limestone. The NO/sub x/ emission limit of 0.6 lb $NO_2/10^6$ Btu is met with excess air up to 25% and bed temperatures to 1670°F. Alumina (Al_2O_3) builds up in the fluidized bed during operation increasing from about 18% in the coal ash to over 65% in the final bed of these runs. At bed temperatures over 1500°F, some of the $CaSO_4$ particles formed are very fine and are rapidly carried out of the bed. Emissions from the 18-inch fluidized-bed combustor, including toxic trace elements and mutagenic activity, were comparable to or lower than those from conventional power plants.

29921 **(DOE/PC/30229—T1) Thermal reactions of aromatics with CaO. Technical progress report, September 1, 1980-April 30, 1981.** Longwell, J.P.; Ellig, D.L.; Krasniak, S.; Lai, S.C.K.; Williams, G.C.; Peters, W.A. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jul 1981. Contract FG22-80PC30229. 63p. NTIS, PC A04/MF A01. Order Number DE81028760.

Experiments were performed near atmospheric pressure for the temperature range 550 to 950°C. Helium carrier gas containing 3 mole % of the vapor phase reactant was passed through approximately 5.5-cm-deep, 0.7-cm-ID packed beds containing calcium oxide or quartz (for comparison studies). Contact times were approximately 2 s and around 5 mg of pure compound were fed in each run. Reaction products and unreacted feed were collected and analyzed. Carbon balances were performed on selected runs. The effects of CaO source and the method of CaO preparation were also investigated. Extents of conversion, and product distributions for n-heptane cracking were similar for calcium oxide and for quartz. However, the temperature for removal of aromatic hydrocarbons from the helium hydrocarbon mixtures in the presence of calcium oxide was reduced 140 to 180°C from that with quartz. The temperature required for 20% conversion of each compound in the presence of calcium oxide and quartz respectively were: 1-methylnaphthalene - 570 and 750°C; toluene - 685 and 825°C; benzene 750 and 890°C; and n-heptane 585 and 610°C. The reactivity of the aromatics increased with addition of a methyl group or a second aromatic ring to the molecule. Coke is the major product from the reaction of each aromatic. Methane yields from 1-methylnaphthalene and toluene were lower in the reactions over calcium oxide. On a unit weight basis calcium oxide obtained by calcining calcium hydroxide at final reaction temperatures was more active for benzene cracking than CaO obtained by calcining limestone. Calcium oxide cracking activity declines as coke is deposited on its surface but may be at least partially regenerated by burning off the coke. Apparent activation energies obtained by fitting a single reaction first order decomposition model to the data were lower for aromatics cracking over CaO compared to quartz but the opposite effect was found for n-heptane.

29922 (DOE/PC/30294—3) Pulverized-fuel combustion: modeling and scaleup methodologies. Third quarterly report, April 1, 1981-June 30, 1981. Lewis, P.F.; Pugh, E.R.; Kemp, N.H.; Gelb, A.; Wolf, T. (Physical Sciences, Inc., Woburn, MA (USA)). Aug 1981. Contract AC22-80PC30294. 30p. (PSI-TR—280). NTIS, PC A03/MF A01. Order Number DE81026546.

Effort this quarter has continued on model improvements, and the data analysis task has begun. Specific work reported includes: model of the heterogeneous reactions of coal chars, work on particle-particle collisions, improvements in the computer code to handle the stiff nature of the particle momentum and energy equations, and identification of a set of experiments with which to start the data analysis. Results of these efforts are: a model for heterogeneous carbon reactions including OH and O reactions, a model for collisional drag effects, improved numerical stability of the code, and beginning of data analysis.

29923 (DOE/PC/30305—T3) Study of the formation of submicron particulates generated by coal combustion. Third quarterly progress report, 1 April 1981-30 June 1981. Sherman, P.M.; Glass, D.R. (Michigan Univ., Ann Arbor (USA). Dept. of Aerospace Engineering). Jul 1981. Contract FG22-80PC30305. 28p. NTIS, PC A03/MF A01. Order Number DE81027447.

Our objective is to investigate the formation of the very small particles so that we may prescribe combustion and heat transfer conditions which will prevent their formation. Emphasis has been largely on perfecting techniques for obtaining electron microscope data which can be correlated with variations in heat transfer and combustion parameters. To facilitate this much of the equipment has been improved for better control and access. Improvements include better sealing of the furnace tube; provision for measurement of the entire flow field downstream of the flame; better control of the exhaust stream; better control of the coal dust feeder; and better control of the temperature of the secondary air. Use of a new and advanced electron microscope has also been obtained on a regular basis. The present program has been focussing on particles in the 50 A to 0.1 micron range. These have been largely overlooked in the past because they are difficult to detect. As detection devices improved, the lower limit of the particle diameter considered has been pushed to smaller and smaller values. It is relatively recently that the importance of the very small particles has emerged as an important problem. The difficulties in investigating the formation of the very small particles are manyfold. In order to photograph them a transmission electron microscope must be used. That means that a microscopically smooth and clean substrate which is transparent to the electron bean must be provided as a collection surface.

29924 (DOE/PC/30306—T3) Basic combustion and pollutant-formation processes for pulverized fuels. Quarterly technical progress report No. 3, 1 April 1981-30 June 1981. Germane, G.J.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 15 Jul 1981. Contract FG22-80PC30306. 46p. NTIS, PC A03/MF A01. Order Number DE81027279.

This contract study of basic combustion and pollutant formation processes for pulverized solid fossil fuels includes coal chars derived from pyrolysis or gasification processes, and coal-water mixtures. Utilization problems with these fuels such as flame stability, fuel handling, pollutant emission, and ash and slag formation in large-scale furnaces may be fundamentally addressed in laboratory reactors using properly scaled operating variables. Characterization of coal-water mixtures (CWM) was initiated to identify handling factors which could affect the combustion and pollutant formation. Methods of CWM preparation and utilization have been studied to help define the approach to be used for this research. Careful design and utilization strategies can improve lab-scale similarity in certain areas with potential commercial-scale applications. The CWM reactor modifications embody design features for detailed space-resolved combustion studies and fabrication has begun. The reactor has been designed to handle up to 45 kilograms (100 pounds) per hour of CWM, with precise control of the inside wall temperatures. Commercial and industrially produced chars were reviewed to determine their status and availability. Six chars were identified and requested. The literature survey was continued, determining those variables and factors that influence char reactivity. Provisions have been made to conduct characterization tests that will enable the selection of two of the six chars for the laboratory-scale combustor tests.

29925 (DOE/PC/40265—1) Computational tools for pulverized-coal combustion. First quarterly report, March 1981-June 1981. Oberjohn, W.J.; Fiveland, W.; Cornelius, D.K.; Wang, J.H.; Schnipke, R.J. (Kerson (James D.), Alliance, OH (USA); Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div.). Jul 1981. Contract AC22-81PC40265. 144p. NTIS, PC A07/MF A01. Order Number DE81028582.

The general objective of this contract is to develop and verify a computer code capable of modeling the major aspects of pulverized-coal combustion. Achieving this objective will lead to design methods applicable to industrial and utility furnaces. The combustion model (COMO) is based mainly on an existing Babcock and Wilcox computer program. The model consists of a number of relatively independent modules that represent the major processes involved in pulverized-coal combustion. Version 1 of COMO will model all of the major features of pulverized-coal combustion but with a number simplifying assumptions. It will be used primarily to determine a satisfactory means of integrating the numerical models of the combustion processes into an overall combustion model, since this is perhaps the major challenge. Later versions will relax these assumptions and incorporate state-of-the-art combustion information. Detailed task descriptions have been prepared, literature searches conducted, and process models selected for Version 1. The formulation and coding of the models was initiated and, in some cases, comparisons with data and other predictions were made. Code development guidelines were prepared and reviewed; the guidelines present the information required to allow process modules to be developed relatively independently, while providing for the subsequent integration of these modules into COMO.

29926 (DOE/PC/40269—1) Combustion characteristics of fine-ground coal. Quarterly technical report, March 1-May 31, 1981. (Institute of Gas Technology, Chicago, IL (USA)). Jul 1981. Contract AC22-81PC40269. 16p. NTIS, PC A02/MF A01. Order Number DE81025439.

This program consists of a research study to investigate the effect of coal particle size on the flame characteristics of pulverized coal. The purpose is to determine if fine grinding will allow replacement of oil by coal in some industrial applications. The Plant Engineering Development Department of General Motors Corporation (GM) and the Research and Development Staff of York-Shipley, Inc. (Y-S), a major boiler manufacturer, are assisting IGT in this effort. These companies have offered to donate time to the program as industrial consultants. Pulverized coal will be fired at about 2 million Btu/hr (approximately 160 lb/hr) in a special experimental furnace designed to collect data on the combustion and heat-transfer characteristics of flames. Combustion trials with No. 6 oil are also planned to allow for direct correlation with the coal combustion data. Some of the information to be obtained from this study will be a determination of how the flame heat release density, mass burning rate, flame temperatures, and heat-transfer characteristics change with fuel particle size (fineness of coal grinding). It will also be possible to directly compare these parameters from the various coal flames with comparable oil flames to determine the feasibility of substituting fine-ground pulverized coal flames for heavy-oil flames. Data will also be collected to allow for the correlation of the flue-gas pollutant emissions with the fuel characteristics. Progress to date has focused on the task of preparing our combustion facility and includes extensive investigations of the equipment to be purchased and installed, system development, and modification of the sampling probes.

29927 (EPRI-WS—80-141) Seminar proceedings: the use of coal in oil-design utility boilers. (Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1981. 235p. NTIS, PC A11/MF A01.

The fifteen papers in this proceedings were given at a utility seminar on the subject of The Use of Coal in Oil-Design Utility Boilers. The seminar, held December 2, 3, and 4, 1980, in Lake

Buena Vista, Florida, was cosponsored by EPRI and the Florida Power & Light Co. Featured were detailed descriptions of the conversion from oil firing to coal firing at the Kwinana Power Station in Western Australia; other papers covered a broad range of related topics including: fundamentals of coal boiler design; effects of coal ash in oil-design boilers; review of recent utility experience with coal-oil mixture fuels; overview of the direct combustion of coal-water slurry; potential for cleaning coal to ash levels acceptable to oil boilers; and definition of emission-control requirements for boilers to satisfy emissions regulations if they were converted to coal. The audience at the seminar was comprised chiefly of utility representatives; papers were presented by experts from related industries, utility personnel, EPRI staff, and consulting firms. Fifteen papers have been entered individually into EDB and ERA. (LTN)

29928 (EPRI-WS—80-141, pp 1.1-1.3) **Sanford coal-oil-mixture project: a study in cooperation.** Mann, R.T. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

Less than a year elapsed between the first discussions about the possibility of large scale testing of coal-oil mixtures at Florida Power & Light company's Sanford plant and the first COM burn there. Details of permit affilations, variances, etc. are discussed briefly. (LTN)

29929 **Fluidized bed char combustion diffusion limited models.** Bukur, D.B.; Amundson, N.R. (Univ. of Houston, TX). *Chemical Engineering Science ;* **36**: No. 7, 1239-1256(1981).

A model based on the two phase theory of fluidization has been developed for prediction of fluidized bed combustor performance. Two different particle combustion mechanisms, known as the single film and the double film theory of particle combustion, have been studied, and in both cases it is assumed that the burning rate of char is diffusion limited. The relative importance and influence of model parameters (i.e. mass transfer rates between the bubbles and the dense phase and the dense phase gas and the particles) as well as operating variables (e.g. excess air, bed temperature, char and sorbent particle feed size) on the combustion efficiency and the carbon loading have been established under conditions which are pertinent to large scale utility boilers. It was found that model predictions are in a qualitative agreement with the experimental observations. The calculated values of char particle temperature are too low to sustain the endothermic carbon dioxide reduction at the surface implying that the double film theory particle combustion mechanism is not realistic under the conditions prevailing in fluidized bed combustors. Also, in case of direct attack of the char particle by oxygen, it was found that the kinetic resistance was not negligible.

29930 **Bubble eruption diameter in a fluidized bed of large particles at elevated temperatures.** Sitthiphong, N.; George, A.H.; Bushnell, D. (Oregon State Univ., Corvallis). Contract EF-77-S-01-2714. *Chemical Engineering Science ;* **36**: No. 7, 1259-1260(1981).

An experiment was conducted in a 0.30 x 0.60 m fluidized bed. A stainless steel gas distributor plate with 171 holes of 6.35 mm diameter in a square array pattern 31.75 x 31.75 was used. High-temperature combustion products from a propane burner were used as a fluidizing gas, and no combustion occurred in the bed itself. From the experiment it was found that in a large-particle bed, the bubble eruption diameter increases significantly with bed temperature when compared under equivalent conditions of static bed height and excess gas velocity. For the particles used in this study excess gas velocity increased with increasing bed temperature. (JMT)

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 29807, 29832, 29881, 29947, 30487

29931 **(DOE/ET/10033—T1) Analysis of the labor productivity decline in the US bituminous coal mining industry. Final technical report as of June 8, 1981.** Hill, F.E.; Cook, F.X.; Herhal, A.J.; Krohta, B.J.; Manuel, E.H. (Ayers (Emory) Associates, Inc., New York (USA)). Jun 1981. Contract AC01-78ET10033. 163p. (FE—3120-2). NTIS, PC A08/MF A01. Order Number DE81028708.

This report describes national, regional, and state-level productivity histories for underground and surface coal mining (separately) during the period 1950 to 1977. The report also presents broad hypotheses regarding the causes of productivity decline.

29932 **(ORNL—5722) Impact of environmental control costs on an indirect coal liquefaction process.** Johnson, P.J.; Wham, R.M.; Singh, S.P.N.; Fisher, J.F. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 218p. NTIS, PC A10/MF A01. Order Number DE81026541.

This report examines the effect on product price of three different scenarios for the control of emissions to the environment by a conceptual, commercial indirect coal liquefaction facility. The plant design utilizes Lurgi dry-ash gasifiers operating on western, subbituminous coal to provide synthesis gas for low-pressure methanol synthesis and subsequent conversion of the methanol to gasoline. Levels of emission control, which are based as much as possible on existing regulations for analogous processes, range from minimal control to more stringent control than that currently in effect. The use of several emission control options and the reduction of plant size are also examined in regard to their effects on product price. Environmental control to current levels would account for 12% of the product price for the facility assumed here. More stringent emission standards would produce an additional 3% increase. Reducing plant size would also raise product price. Two unpredictable factors having the greatest impacts on product price, however, are inflation and the method of financing. It should be noted that emisson control requirements could be postulated which would substantially change the assumed plant design and, consequently, the assumed service factor and the calculated product price.

0160 Health And Safety

REFER ALSO TO CITATION(S) 29897, 31295

29933 **(DOE/ET/12548—6) Safety evaluation methodology for advanced coal extraction systems.** Zimmerman, W.F. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jul 1981. Contract AI01-76ET12548. 105p. NTIS, PC A06/MF A01. Order Number DE81028422.

To be acceptable to the coal industry, an advanced extraction system must provide a significant improvement over conventional systems in cost, safety, environmental impact, and conservation of unmined coal. Qualitative and quantitative evaluation methodologies were developed to assist the designer in determining if a proposed extraction design will be safer than existing systems. The qualitative analysis is a process which tests the new system against regulations and hazards of existing similar systems. The analysis examines the soundness of the design, whether or not the major hazards have been eliminated or reduced, and how the reduction would be accomplished. The quantitative methodology provides the designer with a means of establishing the approximate impact of hazards on injury levels. The results are further weighted by peculiar geological elements, specialized safety training, peculiar mine environmental aspects, and reductions in labor force. The outcome is compared with injury level requirements based on similar, safer industries to get a measure of the new system's success in reducing injuries. This approach provides a more detailed and comprehensive analysis of hazards and their effects than existing safety analyses.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 29804, 29806, 29812, 29813, 30707, 30719

02 PETROLEUM

0202 Geology And Exploration

29934 (CONF-800718—, pp 35) **Method for calculating strontium sulfate solubility.** Fletcher, G.E.; Collins, A.G. (Bartlesville Energy Technology Center, OK). 1980. NTIS (US Sales Only), PC A10/MF A01.

From 3. international symposium on water-rock interaction; Edmonton, Alberta, Canada (14 Jul 1980).

A method of predicting the tendency of brines to deposit strontium sulfate scale is presented. Strontium sulfate solubility product constants were determined in the laboratory throughout the range of temperature, pressure and ionic strength commonly found in brines in low-temperature petroleum reservoirs. (ACR)

0203 Drilling And Production

29935 **(DOE/SF/10762—T1) Field demonstration of the conventional steam drive process with ancillary materials. Quarterly report, October-December 1980.** Eson, R.L.; Shannon, A.M. (Petro-Lewis Corp., Denver, CO (USA); Chemical Oil Recovery Co., Bakersfield, CA (USA)). 10 Jan 1981. Contract FC03-79SF10762. 28p. NTIS, PC A03/MF A01. Order Number DE81026962.

Purpose of this field test is to demonstrate an improved oil recovery process through the use of ancillary materials to steam drive injectors. The ancillary materials are used to reduce injection in steam channels and thus force the injected steam to enter alternate flow paths. During the first two months of this quarter up to 190 incremental barrels of oil per day are being produced by the four patterns receiving ancillary materials. Preliminary work began on the evaluation of the producing temperatures, steam injection profiles, chemical tracer surveys, casing vent gas emissions and residual oil saturations in the six observation wells drilled.

29936 **(DOE/SF/10762—T2) Field demonstration of the conventional steam drive process with ancillary materials. Quarterly report, July-September 1980.** Alden, D.R.; Eson, R.L. (Petro-Lewis Corp., Denver, CO (USA); Chemical Oil Recovery Co., Bakersfield, CA (USA)). 7 Oct 1980. Contract FC03-79SF10762. 13p. NTIS, PC A02/MF A01. Order Number DE81026849.

Purpose of this field test is to demonstrate an improved oil recovery process through the use of ancillary materials to steam drive injectors. The ancillary materials are used to reduce injection in steam channels and thus force the injected steam to enter alternate flow paths. Evaluation of the injection well production curves shows that currently there is over 125 incremental barrels of oil per day being produced by the four patterns receiving ancillary materials and that the incremental oil rate has been steadily increasing since the initial treatment in January, 1980. Preliminary work began on the evaluation of the producing temperatures, steam injection profiles, chemical tracer surveys, casing vent gas emissions and residual oil saturations in the six observation wells drilled.

29937 **Deep-down energy quest.** *Marathon World ;* **18**: No. 1, 15-19(1981).

Frequently, petroleum and natural gas deposits do not lie in pools, but are dispersed in low permeability rock formations. In order to exploit such deposits, a technique known as hydraulic fracturing, or hydrofracing is being employed. Hydraulic fracturing involves pumping thousands of gallons of water and tons of sand down a wellbore with such pressure that it wedges into hard-rock formations and splits them open. The object of the technique is to confine the force so tightly that it sends cracks or fractures coursing through the oil- and gas-bearing rock, and then after pumping stops, the sand remains behind to keep the fractures propped open, to furnish a pathway for hydrocarbons to flow to the wellbore. In this article, a nontechnical review of the hydraulic fracturing technique is presented.

29938 **Downhole steam generator with improved preheating/cooling features.** Donaldson, A.B.; Hoke, D.E.; Mulac, A.J. (to Dept. of Energy). US Patent Application 195,966. 10 Oct 1980. 20p.

An apparatus is described for downhole steam generation employing dual-stage preheaters for liquid fuel and for the water. A first heat exchange jacket for the fuel surrounds the fuel/oxidant mixing section of the combustor assembly downstream of the fuel nozzle and contacts the top of the combustor unit of the combustor assembly, thereby receiving heat directly from the combustion of the fuel/oxidant. A second stage heat exchange jacket surrounds an upper portion of the oxidant supply line adjacent the fuel nozzle receiving further heat from the compression heat which results from pressurization of the oxidant. The combustor unit includes an inner combustor sleeve whose inner wall defines the combustion zone. The inner combustor sleeve is surrounded by two concentric water channels, one defined by the space between the inner combustor sleeve and an intermediate sleeve, and the second defined by the space between the intermediate sleeve and an outer cylindrical housing. The channels are connected by an annular passage adjacent the top of the combustor assembly and the countercurrent nature of the water flow provides efficient cooling of the inner combustor sleeve. An annular water ejector with a plurality of nozzles is provided to direct water downwardly into the combustor unit at the boundary of the combustion zone and along the lower section of the intermediate sleeve.

0204 Processing

REFER ALSO TO CITATION(S) 29948

29939 **(NP—1903561) Pilot study on the isolation metabolism and adaptation of microorganisms to Santa Rosa Tar-Sand hydrocarbons: Phase I. Final report, January 1, 1980-March 31, 1981.** Sanchez, G. (Eastern New Mexico Univ., Portales (USA). Dept. of Biology). Jul 1981. 24p. (EMD—2-68-3409). New Mexico Energy and Minerals Department, Santa Fe. Order Number DE81903561.

This report describes and discusses a project which involved the isolation, identification, and study of microorganisms with hydrocarbon-metabolizing activities. The hydrocarbons specifically under consideration were those derived from the Santa Rosa Tar Sand deposit in Guadalupe County, New Mexico. The hydrocarbons were extracted and incorporated into growth media which were used to isolate and further study the microorganisms. Various study parameters were used such as growth and respiratory rates, isolation of mutant variants and some chemical analysis. The microorganisms were tested under various physical and chemical conditions in order to establish optimal conditions of growth and reproduction. The work was considered as a pilot study to determine the feasibility of use of microorganisms in synthetic fuel production and development. Conclusions are made that the potential exists and that work should continue to further develop the utilization of microorganisms in the synfuels field.

29940 **Synthesis and properties of two catalytically important zeolites.** Kerr, G.T. (Mobil Research and Development Corp., Princeton, NJ). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 281-291(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

This paper presents the definition of zeolites and focuses on the synthesis and physiocochemical properties of two catalytically and commercially important synthetic zeolites, zeolite Y and zeolite ZSM-5. Discussed are: the composition of zeolites, zeolite structures and ion exchange, zeolite synthesis, zeolite sorption, the generation of Bronsted acidity in zeolites, and acid site concentration and cracking activity of HZSM-5. (DMC)

29941 Unifying principles in zeolite chemistry and catalysis. Rabo, J.A. (Union Carbide Corp., Tarrytown, NY). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 293-313(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

This discussion is intended to review some of the key chemical and catalytic features of both alkali and acidic zeolites, and to attempt to relate their chemistry to their catalytic properties. Up to the present, all commercial applications of zeolite catalysts have been carried out with acidic zeolites. Recent investigations of zeolite chemistry revealed several important features which appear common to both alkali and acidic zeolites. This new chemical evidence raises the possibility that the underlying physicochemical features of both types of zeolites play a role in catalysis. A large body of experimental evidence in zeolite chemistry and zeolite catalysis suggests that the key distinguishing features of zeolite catalysts used in industrial application are: 1. The catalytic selectivity based on molecular sieve effects or on diffusion limitations. 2. The high concentration of strongly ionic hydrogen (H^+) atoms attached to framework oxygen atoms. 3. The large enhancement of ionization reactions and the stabilization of carbenium ions. 4. The high concentration of hydrocarbon reactants within zeolite crystals, resulting in the enhancement of bimolecular reaction steps over unimolecular reaction steps.

29942 Technological applications of zeolites in catalysts. Heinemann, H. (Univ. of California, Berkeley). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 315-328(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

Zeolites have been used in the petroleum industry as catalysts in both catalytic cracking and hydrocracking since the early 1960's. Better than 90% of the free-world cracking units now use zeolite catalysts. Some of the processes in which zeolite catalysts have found application are described in this article. (DMC)

0205 Products And By-products

29943 Mechanism of ethylene epoxidation. Sachtler, W.M.H.; Backx, C.; Van Santen, R.A. (Shell Research, Amsterdam, Netherland). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 127-149(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

During the epoxidation of olefins there appears to be 2 relevant facts: (1) In the liquid phase, the direct reaction of molecular oxygen with an olefin never results in significant yields of epoxides; and (2) No homogeneous catalyst is known that efficiently catalyzes the epoxidation of olefin with molecular dioxygen. This paper briefly reviews some results on epoxidation reaction kinetics and then inspects the results of work directed toward characterizign adsorption complexes. This includes IR data obtained with supported silver and physical measurements on oxygen adsorption. The relevance of all these data on the mechanism of ethylene epoxidation in the steady state of a working catalyst, under industrial conditions, will be addressed. Discussed are: kinetic data on ethylene oxidation, characterization of oxygen adsorbed on silver, and recent results of oxygen-ethylene interaction with unsupported silver. (DMC)

29944 Ethylene oxidation: exploratory research. Porcelli, J.V. (Halcon Research and Development Corp., New York, NY). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 151-162(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

The steps involved in developing commercially successful catalysts and the ways in which the techniques and technologies utilized have changed over time are described, primarily from the standpoint of the author's experiences during 20 years at Halcon/Scientific Design. The discussion is limited to the direct oxidation of ethylene to ethylene oxide in the vapor phase over catalysts containing silver.

29945 Technology for the manufacture of ethylene oxide. Zomerdijk, J.C.; Hall, M.W. (Shell Internationale Chemie Maatschappij B.V., Hague, Netherlands). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 163-185(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

In the petrochemical industry, complex molecular structures are built up from relatively simple building units such as ethylene oxide. Ethylene oxide is a highly reactive, toxic, inflammable, and, sometimes, autoexplosive chemical. The manufacturing of this compound is discussed in this article. Essentially, ethylene oxide is produced by the carefully controlled oxidation of ethylene over a silver catalyst. Described are: ethylene oxide and its derivatives; ethylene oxide plants and capacities; the basic chemistry; ethylene oxide process technology using oxygen or air; design issues; technology improvements; and future developments. (DMC)

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 29949, 30714, 30715, 30718, 30720, 30721, 30722

29946 (DOE/EIA—0206-79) Performance profiles of major energy producers 1979. (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1981. 117p. NTIS, PC A06/MF A01. Order Number DE81028468.

The purpose of this report is to examine year-to-year developments in the operations of 26 major US energy companies on a corporate level and also by major line of energy business and by major functions within each line of business. The period covered is 1977 to 1979. Comparisons of income and investment flow are featured and related to functionally allocated net investment in place. The presentation seeks to identify similarities and dissimilarities in results across lines-of-business activity or by firm size.

29947 (EPRI-WS—80-141, pp 13.1-13.8) **Fuel supplier's purview.** Chloupek, F.J.; McKay, G.A. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

Atlantic Richfield Company, a diversified natural resource company, is active in all phases of the energy industry. To be successful in today's environment requires an assessment of probable future supply and demand of conventional and alternative energy sources. In the conventional utility fuel market, this means an assessment of future oil supply as well as coal availability as a function of demand. For the alternative utility fuel market, this results in an assessment of the current market as well as changes likely to take place. These changes encompass alterations in fuel preparation methods as well as changes in the fuels themselves. Dependence on imported oil supplies impacts heavily on the economy and national security of the US. The availability of supply depends greatly on a very troubled Middle East. Vastly increased investment in domestic production can help in reducing this dependence. However, an attractive alternative is domestic coal reserves which are abundant, competitive, and show much potential for increased production. On the fuel preparation front, Atlantic Richfield, partially through EPRI sponsored projects, has done extensive work in the coal cleaning area. The concept of a coal refinery of the future has evolved. This plant would have the flexibilty to process coals with different basic characteristics to provide a consistent product. Cleaned coal, coal-oil mixtures and, in the future, coal-water slurries would make up a product slate which, through processing flexibility, can be tailored to the individual customers needs. Through these conventional and alternate fuel routes, fuel suppliers will meet the needs of utilities, while the US utility industry will be able to meet the needs of the energy consuming public.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 31197, 31198, 31201, 31212, 31213, 31214, 31215

29948 **(PB—81-117038) Alaska Petrochemical Company refinery and petrochemical facility, Valdez, Alaska. Final environmental impact statement.** (Environmental Protection Agency, Seattle, WA (USA). Region X). Apr 1980. 349p. NTIS, PC A15/MF A01.

The objective of this project is the issuance of a New Source National Pollution Discharge Elimination System (NPDES) permit for wastewater discharge from the proposed Alaska Petrochemical Company (ALPETCO). ALPETCO proposes to build a new refinery and petrochemical facility to process 150 thousand barrels per day of Alaskan North Slope crude oil to supply the west coast petroleum fuels market. Other facilities would include a products shipping dock, the industrial wastewater treatment plant and an onsite power plant.

0210 Legislation And Regulation

29949 **(EMD—81-45) Department of Energy needs to resolve billions in alleged oil-pricing violations.** (General Accounting Office, Washington, DC (USA)). 31 Mar 1981. 72p. General Accounting Office, Gaithersburg, MD. Order Number DE81904052.

As of January 1981, the Department of Energy (DOE) had alleged over $13 billion in oil pricing violations. However, only $4.2 billion of this total has been resolved primarily because of oil industry legal challenges to DOE's regulations. Even when DOE was able to negotiate settlements with oil companies, it was generally unable to ensure that restitution was made to injured parties. Because petroleum pricing has been decontrolled and because most alleged violations have not been settled, DOE needs to pursue its enforcement efforts to bring these violations to a fair and orderly resolution.

0230 Properties

REFER ALSO TO CITATION(S) 30785

0250 Combustion

REFER ALSO TO CITATION(S) 29927, 29928, 30477, 30478, 30479, 30482, 30483, 30484, 30485, 30488

03 NATURAL GAS

0304 Products And By-products

REFER ALSO TO CITATION(S) 30108

0305 Health And Safety

REFER ALSO TO CITATION(S) 29955

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 29946

29950 **Natural gas-retail.** Grevenow, D.E. (Wisconsin Gas Co., Milwaukee). pp 88-96 of Proceedings of the 1980 rate symposium on problems of regulated industries. Columbia, MO; University of Missouri (1980).

From 1980 rate symposium on problems of regulated industries; Kansas City, MO, USA (10 Feb 1980).

Natural gas ratemaking at the distribution company level is discussed in this article. Marginal-cost pricing, lifeline rates, flate rates, inverted rates, seasonal rates, and benchmark rates are described. A detailed explanation of the auction rate is presented. (DMC)

29951 **Incremental pricing.** Thomas, J.P. pp 220-232 of Proceedings of the 1980 rate symposium on problems of regulated industries. Columbia, MO; University of Missouri (1980).

From 1980 rate symposium on problems of regulated industries; Kansas City, MO, USA (10 Feb 1980).

Incremental-cost pricing as outlined in the Natural Gas Policy Act is evaluated in this article. The author concludes that incremental pricing is merely a revenue assignment methodology to allocate a disproportionate share of gas cost, therefore revenue resonsbility to industrial users. If implemented as proposed, the small user would not receive the protection which Congress envisioned. The benefits these customers currently derive from sales to industrial users would be driven off the natural gas system. (DMC)

29952 **Nstural gas rate design in Wisconsin.** Miller, J.G. pp 244-260 of Proceedings of the 1980 rate symposium on problems of regulated industries. Columbia, MO; University of Missouri (1980).

From 1980 rate symposium on problems of regulated industries; Kansas City, MO, USA (10 Feb 1980).

The direction of natural gas rate designs in Wisconsin can be described and analyzed by reviewing the experience of Wisconsin Power and Light Company (WP & L) because the Wisconsin Public Service Commission (WPSC) used a WP & L natural gas rate case, as its test case to establish Wisconsin policy. This paper covers the proposed and ordered rate designs in this case, and includes a discussion of the costing methodologies and an analysis of customer response during the first year that these rates were effective. The end result of the WP & L test case was the establishment of WPSC policy which is now being implemented in various forms by the other natural gas utilities in Wisconsin. It is still too early to measure the impact these new and different rate designs have had or will have on customer's consumption decisions.

29953 **Trends and issues in retail rate design: the Montana experience or the Montana Power Company experience.** Haffey, J.D. pp 261-327 of Proceedings of the 1980 rate symposium on problems of regulated industries. Columbia, MO; University of Missouri (1980).

From 1980 rate symposium on problems of regulated industries; Kansas City, MO, USA (10 Feb 1980).

The cost assignment, rate class definition, and rate design orders by the Montana Public Service Commission to the Montana Power Company are discussed in this article. The rates prepared in compliance with the order and the rates existing just prior to the order are presented. What the order will mean to the customers of the utility in terms of gas prices is illustrated. The proceedings of the Hearing before the Public Service Commission November 19, 1979 are included. Data are presented on summer and winter billings. A financial statement of the Montana Power Company, natural gas cost information, cost of service information, and cost allocations are also presented. (DMC)

29954 **Standby or supplemental rates.** Smallwood, E.W. pp 328-333 of Proceedings of the 1980 rate symposium on problems of regulated industries. Columbia, MO; University of Missouri (1980).

From 1980 rate symposium on problems of regulated industries; Kansas City, MO, USA (10 Feb 1980).

The story behind a request for standby or supplemental rates by the Washington Gas Light Company is related by a representative of the company. These rates would apply to customers with electric heat pumps who only use gas for space heating at or near the system peak. These customers do not free up any pipeline demand, storage gas, peak shaving gas, nor facilitate the adding of new customers without the expanding of storage capacity. The question of whether or not an electric heat pump should be coupled with gas furnaces is also addressed. (DMC)

0308 Environmental Effects

29955 Simulation of LNG vapour spread and dispersion by finite element methods. Chan, S.T.; Gresho, P.M.; Lee, R.L. (Lawrence Livermore Lab, Calif). *Applied Mathematical Modelling ;* **4**: No. 5, 335-344(Oct 1980).

Two finite element models, one based on solving the time-dependent, two-dimensional conservation equations of mass, momentum, and energy, with buoyancy effects included via the Boussinesq approximation, the other based on solving the otherwise identical set of equations except using the hydrostatic assumption, are described and used to predict some aspects of the vapor dispersion phenomena associated with LNG spills. A number of controlled numerical experiments, representing a reasonable expected range of LNG spill scenarios and atmospheric conditions, have been carried out. Based on a comparison of the results obtained with these finite element models, some data regarding the applicability and limitations of the hydrostatic assumption for predicting LNG vapor spread and dispersion are established. 10 refs.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 29937

29956 Effects of friction on hydraulic fracture growth near unbonded interfaces in rocks. Anderson, G.D. (Lawrence Livermore Lab, Calif). *SPEJ, Society of Petroleum Engineers Journal ;* **21**: No. 1, 21-29(Feb 1981).

Small-scale laboratory experiments were performed to study the growth of hydraulically driven fractures in the vicinity of an unbonded interface in rocks. The purpose was to evaluate under which conditions the hydraulic fractures would cross the interface. It is found that as the interface surface friction coefficient was decreased, the normal stress had to be increased for a hydraulic fracture to cross the interface. The frictional shear stress that the interface can support without slippage appears to be critical in determining fracture growth across the interface. 10 refs.

29957 (UCRL—50036-80-2) LLNL gas-stimulation program. Semiannual progress report, April-September 1980. Hanson, M.E.; Anderson, G.D.; Shaffer, R.J. (Lawrence Livermore National Lab., CA (USA)). 15 Dec 1980. Contract W-7405-ENG-48. 60p. NTIS, PC A04/MF A01.

This report summarizes the research and accomplishments of the LLNL Gas Stimulation program during the second half of FY 80. We have continued to analyze effects of frictional interfaces on pressurized fractures. Our results correlate with laboratory experiments and indicate characteristics of strain energy buildup across the interface from the pressurized fracture. Additionally, we have discovered that variation in friction along an interface results in the same abrupt steps in the fracture path as we observed in mineback operations. Various calculational schemes for coupling simple flow descriptions with the elastic fracture models are not being used. Experimentally we also have completed preliminary pressurized fracture experiments in rock under an implied varying stress field. As expected, we found that the fracture path deviates due to changes in stress; our geologic studies at Rangely, Colorado indicate that the azimuthal orientation of the in situ stress is related to structure. In our ultrasonic in situ stress measurement feasibility study, we demonstrated that acoustic waves of various modes can be generated and received on a single-face configuration with newly designed, transducer-wedge arrangement. Furthermore, we have made pressure/volume measurements of Mesaverde sandstone and shale and have completed a failure-envelope study for the Mesaverde shale, loaded both parallel and perpendicular to bedding.

0330 Properties

REFER ALSO TO CITATION(S) 30785

04 OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 30713

29958 (DOE/LETC/RI—81-2) Bibliography of publications dealing with tar sands. (Department of Energy, Laramie, WY (USA). Laramie Energy Research Center). Sep 1981. 296p. NTIS, PC A13/MF A01. Order Number DE81026146.

To assist industry in the development of tar sands (oil sands), a compilation of technical reports, patents, journal articles and books has been prepared. The emphasis of this bibliography has been the US resource and its development. Also included are pertinent articles on non-domestic tar sand and related heavy oil resources and their development. The subjects include: geology and resource evaluation; chemical and physical properties; in-situ recovery; upgrading and refining; history; environmental; and miscellaneous (includes general survey papers; resource development, health and safety, economics, etc.).

0403 Drilling, Fracturing, And Mining

29959 (DOE/LC/10066—T1) Design and analysis of a hydraulic fracture in the tar sand at Northwest Asphalt Ridge, Utah. Sinha, K.P.; Abou-Sayed, A.S.; Jones, A.H. (Terra Tek, Inc., Salt Lake City, UT (USA)). Sep 1979. Contract AC20-79LC10066. 112p. NTIS, PC A06/MF A01. Order Number DE81027449.

Material properties and the in-situ stress field information are used to design and analyze a hydraulic fracture experiment in tar sand. Simplified mathematical models have been used to correlate the measured tilts (uplift gradient) at the surface during fracture treatment to the fracture orientation and geometry. Recommendations are made for post-fracture investigation to ascertain the validity of the analysis and the predictability of fracture orientation. Measurements and analysis suggest that the induced fracture was initiated horizontally but turned to a near vertical plane on propagation. This is considered to be a result of the near hydrostatic stress state in which the induced fracture has no preferred orientation and local inhomogeneities, etc., may change the propagation direction.

29960 (LA—8769-PR) Explosively produced fracture of oil shale. Progress report, October-December 1980. Sinoradzki, H.M. (ed.). (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01. Order Number DE81028378.

A major technological limit on the in situ retorting of oil shale is the effective rubbling of the rock. Consequently, efficient and economical recovery of oil from shale is dependent directly on developing a more sophisticated blasting technology. Crucial to this technology is understanding the behavior of the explosive. Calculations of pressures and shock-front positions are developed and compared graphically to the aquarium-test experimental data for two different diameter explosive configurations for ammonium nitrate/fuel oil (ANFO). Once the explosive reaction is understood, analytical and computational methods can be developed to simulate the blasting of the rock. Such computer modeling will allow the phenomenology of blasting to be studied and will eliminate the need for many expensive field tests. The basis for using predictive modeling and its application to predict rock fracturing is explained, and comparisons of calculations to field experimental data are presented. Also discussed is the theory of effective-elastic-moduli reduction in a transversely isotropic material containing penny-shaped cracks. It is applied to the bedded crack model in which all cracks are in the horizontal (bedding) plane of the material, as they are in oil shale. The technique equates the total body strain to the sum of the straining of the material matrix and the additional strain caused by the opening and shearing of cracks. Finally, the permeability of explosively fractured oil shale is related to the statistical distribution of cracks in the rock and their instability as stress levels increase. An expression for the specific permeability of oil shale under high stresses is derived. 22 figures.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 29906, 29939

29961 **(DOE/ET/14363—T6) Concentrating oil shale by froth flotation. Project status report, April 1-June 30, 1981.** Krishnan, G.N. (SRI International, Menlo Park, CA (USA)). 10 Aug 1981. Contract AC01-80ET14363. 11p. NTIS, PC A02/MF A01. Order Number DE81029126.

Froth flotation of the Eastern shale yielded a concentrate having a kerogen concentrate of 37.0 wt % compared to 8.0 wt % kerogen content in the original shale.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 31319

29962 **(DOE/EV/02958—T1) Development of newer methods for the isolation and identification of certain components found in complex mixtures derived from energy sources and the determination of their biological activity via bioassay systems. Progress report, August 1980-July 1981.** Lipsky, S.R. (Yale Univ., New Haven, CT (USA). School of Medicine). Jul 1981. Contract AS02-76EV02958. 29p. (COO—2958-5). NTIS, PC A02/MF A01. Order Number DE81028311.

A composite sample of Paraho crude oil was fractionated and the fractions chemically identified by multidimensional gas chromatography. The fractions were then bioassayed to determine their biological activity. (ACR)

29963 **(DOE/EV/10404—T1) Identification and toxicity of fractionated-shale-oil components.** Wittnebel, K.; Shelly, D.C.; Ho, C.N.; Warner, I.M.; Quarles, J.M. (Texas A and M Univ., College Station (USA)). 1981. Contract AS05-80EV10404. 17p. NTIS, PC A02/MF A01. Order Number DE81028460.

A procedure for the separation and identification of polynuclear aromatic hydrocarbons (PNAs) in shale oil is presented. This procedure comprises two steps. First, the shale oil is separated into fractions according to ring size on a Chromosorb LC-9 normal phase column. Then each of these fractions are separated into individual components and identified using an analytical reversed-phase Ultrasphere ODS 5μm column. In addition, toxicity studies are carried out on each fraction obtained from the amine column to indicate which class of PNAs warrants special attention and analysis. The results of this approach are reported here.

0407 Health And Safety

REFER ALSO TO CITATION(S) 29963, 31295

0410 Enviromental Aspects

REFER ALSO TO CITATION(S) 29962, 31195, 31295

29964 **(DOE/LC/10787—51) Vegetation: ecoclimatic and soil factors. Final environmental research report.** (Geokinetics, Inc., Concord, CA (USA); ERO Associates, Conifer, CO (USA)). 1979. Contract FC20-78LC10787. 119p. NTIS, PC A06/MF A01.

Vegetation studies were begun on the LOFRECO site during the spring of 1978 and continued through the summer of 1979. The principal components of the two year intensive study include collection and analysis of data in the areas of vegetation, ecoclimate, and soils. This report contains the results of the two-year study, presenting data collected from the three main study topics and interpretive analyses of intra-topical correlations. First year (1978) data, including one-time soil studies, have been previously presented in a series of reports (Olgeirson and Martin 1978, Olgeirson 1979a, 1979b, 1979c). Data collected during the second year of study are presented in this report along with first year information (Appendices A through D and Map Pockets). The body of the report combines and correlates data from the permanent sampling sites for both of the years studied. Vegetation, soils, and ecoclimate data are considered separately in these discussions. Correlations and interrelationships between the three main topics are discussed in later sections. Conclusions of the studies are given as a summation of the separate and interrelated findings and as a basis for recommended monitoring programs. An attempt has been made to increase readability by restricting the large amount of data to inclusion into textual areas of the report only as summarized figures and tables. Supporting data have all been placed in the appendices.

29965 **(DOE/LC/10787—51(App.A-A4)) Vegetation: ecoclimatic and soil factors. Final environmental research report.** (Geokinetics, Inc., Concord, CA (USA); ERO Associates, Conifer, CO (USA)). 1979. Contract FC20-78LC10787. 187p. NTIS, PC A09/MF A01.

Vegetation studies were begun on the LOFRECO site during the spring of 1978 and continued through the summer of 1979. The principal components of the two year intensive study include collection and analysis of data in the areas of vegetation, ecoclimate, and soils. This report contains the results of the two-year study, presenting data collected from the three main study topics and interpretive analyses of intra-topical correlations. First year (1978) data, including one-time soil studies, have been previously presented in a series of reports. Data collected during the second year of study are presented in this appendix.

29966 **(PB—81-852527) Environmental impacts of oil shale waste diposal. January 1976-June 1980 (citations from the Energy Data Base). Report for January 1976-June 1980.** Frey, J.H. (New England Research Application Center, Storrs, CT (USA)). Jul 1980. 82p. NTIS PC N01/MF N01.

This retrospective bibliography contains citations concerning the impacts upon the environment of the disposal of wastes from the mining and processing of oil shale. Methods for the control or minimization of environmental damage caused by these activities are also covered. (Contains 67 citations.)

29967 **(DOE/LC/10787—51(App.A5-E1)) Vegetation: ecoclimatic and soil factors. Final environmental research report. Appendices A5-E1.** (Geokinetics, Inc., Concord, CA (USA); ERO Associates, Conifer, CO (USA)). 1979. Contract FC20-78LC10787. 188p. NTIS, PC A09/MF A01.

Vegetation studies were begun on the LOFRECO site during the spring of 1978 and continued through the summer of 1979. The principal components of the two year intensive study include collection and analysis of data in the areas of vegetation, ecoclimate, and soils. This report contains the results of the two-year study, presenting data collected from the three main study topics and interpretive analyses of intra-topical correlations. First year (1978) data, including one-time soil studies, have been previously presented in a series of reports.

05 NUCLEAR FUELS

0501 Reserves

29968 **(DOE/ER/10110—T1) Uranium resource assessments.** (Resources for the Future, Inc., Washington, DC (USA)). 15 Jul 1981. Contract AC01-78ER10110. 284p. NTIS, PC A13/MF A01. Order Number DE81027018.

The objective of this investigation is to examine what is generally known about uranium resources, what is subject to conjecture, how well do the explorers themselves understand the occurrence of uranium, and who are the various participants in the exploration process. From this we hope to reach a better understanding of the quality of uranium resource estimates as well as the nature of the exploration process. The underlying questions will remain unanswered. But given an inability to estimate precisely our uranium resources, how much do we really need to know. To answer this latter question, the various Department of Energy needs for uranium resource estimates are examined. This allows consideration of whether or not given the absence of more complete long-term supply data and the associated problems of uranium deliverability for the electric utility industry, we are now threat-

ened with nuclear power plants eventually standing idle due to an unanticipated lack of fuel for their reactors. Obviously this is of some consequence to the government and energy consuming public. The report is organized into four parts. Section I evaluates the uranium resource data base and the various methodologies of resource assessment. Part II describes the manner in which a private company goes about exploring for uranium and the nature of its internal need for resource information. Part III examines the structure of the industry for the purpose of determining the character of the industry with respect to resource development. Part IV arrives at conclusions about the emerging pattern of industrial behavior with respect to uranium supply and the implications this has for coping with national energy issues.

29969 **(USGS-OFR—79-1651) Formation and resulfidization of a South Texas roll-type uranium deposit.** Goldhaber, M.B.; Reynolds, R.L.; Rye, R.O. (Geological Survey, Washington, DC (USA)). 1979. 41p. Geological Survey, Washington, DC.

Core samples from a roll type uranium deposit in Live Oak County, south Texas have been studied and results are reported for Se, Mo, FeS_2 and organic-carbon distribution, sulfide mineral petrology, and sulfur isotopic composition of iron-disulfide phases. In addition, sulfur isotopic compositions of dissolved sulfate and sulfide from the modern ground water within the ore bearing sand have been studied. The suite of elements in the ore sand and their geometric relationships throughout the deposit are those expected for typical roll-type deposits with well-developed oxidation-reduction interfaces. However, iron-disulfide minerals are abundant in the altered tongue, demonstrating that this interval has been sulfidized after mineralization. Iron disulfide minerals in the rereduced interval differ mineralogically and isotopically from those throughout the remainder of the deposit. The resulfidized sand contains dominantly pyrite that is enriched in ^{34}S whereas the sand beyond the altred tongue contains abundant marcasite that is enriched in the light isotope, ^{32}S. Textural relationships between pyrite and marcasite help to establish relative timing of iron disulfide formation. Based on this evidence, the deposit formed in at least two stages: (1) a pre-ore process of host rock sulfidization which produced disseminated pyrite as the dominant iron disulfide phase; and (2) an ore-stage process which led to the development of the uranium roll with emplacement of the characteristic suite of minor and accessory elements and which produced abundant isotpically light marcasite. The host rock was modified by a post-ore stage of resulfidization which precipitated isotopically heavy pyrite. Sulfur isotopic compositions of sulfide and sulfate present in modern ground water within the host sand differ greatly form sulfur isotopic composition of iron disulfides formed during the resulfidization episode.

0502 Exploration

REFER ALSO TO CITATION(S) 30053

29970 **(DPST—81-146-7) Needles 1^0 x 2^0 NTMS area, California and Arizona, data report (abbreviated). National uranium resource evaluation program: hydrogeochemical and stream sediment reconnaissance.** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). May 1981. Contract AC09-76SR00001. 18p. (GJBX—232-81). NTIS, PC A02/MF A01. Order Number DE81029065.

Includes 6 sheets of 48x reduction microfiche.

Surface sediment samples were collected at 1672 sites, at a target sampling density of one site per 13 square kilometers. Ground water samples were collected at 49 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data from ground water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements where applicable (water temperature, well description, and scintillometer reading), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). Helium analyses are given for ground water. Data from sediment sites include (1) stream water chemistry measurements from sites where water was available and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Samples site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements; U/Th, U/Hf, U/(Th + Hf), and U/La ratios; and scintillometer readings at sediment sample sites are included on the microfiche. Uranium concentrations in the sediments which were above limits ranged from 0.10 to 33.90 ppM. The mean of the logarithms of the uranium concentrations was 0.52. Clusters of uranium values greater than 10 ppM occur in quadrangles AH, BH, and DA.

29971 **(GJBX—114(81)) Statistical techniques applied to aerial radiometric surveys (STAARS): series introduction and the principal-components-analysis method.** Pirkle, F.L. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Apr 1981. Contract AC13-76GJ01664. 62p. NTIS, PC A04/MF A01. Order Number DE81029177.

STAARS is a new series which is being published to disseminate information concerning statistical procedures for interpreting aerial radiometric data. The application of a particular data interpretation technique to geologic understanding for delineating regions favorable to uranium deposition is the primary concern of STAARS. Statements concerning the utility of a technique on aerial reconnaissance data as well as detailed aerial survey data will be included.

29972 **(GJBX—128-81) Geologic summary of the Owens Valley drilling project, Owens and Rose Valleys, Inyo County, California.** Schaer, D.W. (comp.). (Bendix Corp., Kansas City, MO (USA)). Jul 1981. Contract AC13-76GJ01664. 225p. NTIS, PC E08/MF A01. Order Number DE81028164.

Includes 1 sheet of 12x reduction microfiche.

The Owens Valley Drilling Project consists of eight drill holes located in southwest Inyo County, California, having an aggregate depth of 19,205 feet (5853 m). Project holes penetrated the Coso Formation of upper Pliocene or early Pleistocene age and the Owens Lake sand and lakebed units of the same age. The project objective was to improve the reliability of uranium-potential-resource estimates assigned to the Coso Formation in the Owens Valley region. Uranium-potential-resource estimates for this area in $100 per pound U_3O_8 forward-cost-category material have been estimatd to be 16,954 tons (15,384 metric tons). This estimate is based partly on project drilling results. Within the Owens Valley project area, the Coso Formation was encountered only in the Rose Valley region, and for this reason Rose Valley is considered to be the only portion of the project area favorable for economically sized uranium deposits. The sequence of sediments contained in the Owens Valley basin is considered to be largely equivalent but lithologically dissimilar to the Coso Formation of Haiwee Ridge and Rose Valley. The most important factor in the concentration of significant amounts of uranium in the rock units investigated appears to be the availability of reducing agents. Significant amounts of reductants (pyrite) were found in the Coso Formation. No organic debris was noted. Many small, disconnected uranium occurrences, 100 to 500 ppM U_3O_8, were encountered in several of the holes.

29973 **(GJBX—220-81) Hydrogeochemical and stream sediment reconnaissance basic data for circle quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 May 1981. Contract W-7405-ENG-26. 157p. (K/UR—322). NTIS, PC E06/MF $3.50. Order Number DE81027990.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 1321 water samples from the Circle Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

29974 **(GJBX—221-81) Hydrogeochemical and stream sediment reconnaissance basic data for Nabesna Quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 May 1981. Contract W-7405-ENG-26. 145p. (K/UR—328). NTIS, PC E06/MF A01. Order Number DE81028765.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 1236 water samples from the Nebesna Quadrangle, Alaska. The samples were collected by Los Alamos Scientific Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

29975 **(GJBX—223-81) Hydrogeochemical and stream sediment reconnaissance basic data for Table Mountain quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 May 1981. Contract W-7405-ENG-26. 140p. (K/UR—332). NTIS, PC E06/MF $3.50. Order Number DE81027991.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 1128 water samples from the Table Mountain Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

29976 **(GJBX—224-81) Design of a borehole data-acquisition/transmission system. Final report, Volume I.** Hancock, R.L.; Bowden, J.C. (Science Applications, Inc., La Jolla, CA (USA)). Jun 1981. Contract AC13-76GJ01664. 197p. (SAI—272-81-147-LJ). NTIS, PC A09/MF A01. Order Number DE81028936.

Objective of the BDATS program was to design, construct, and demonstrate a borehole probe and associated uphole modules that would allow downhole collection of data from any of several borehole probes and would allow digital transmission of that data uphole to a computer. Specifically, the system was electrically and mechanically configured to interface to six separate borehole probes and a computer in a R and D logging vehicle. However, the system can be used with other types of probes.

29977 **(GJBX—227-81) Hydrogeochemical and stream sediment reconnaissance basic data for Eagle Quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 May 1981. Contract W-7405-ENG-26. 191p. (K/UR—327). NTIS, PC E07/MF A01. Order Number DE81028637.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 1377 water samples from the Eagle Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

29978 **(GJBX—230-81) Hydrogeochemical and stream sediment detailed geochemical survey for Edgemont, South Dakota; Wyoming.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Jun 1981. Contract W-7405-ENG-26. 50p. (K/UR—38Suppl.1). NTIS, PC A03/MF A01. Order Number DE81029062.

An area on the Long Mountain Structure Zone was chosen for examination of hydrogeochemical data. The data suggest the presence of a hydrogeochemical boundary approximately 5 to 7 km (3-1/2 to 4-1/2 mi) downdip of exposed mines and prospects in the Inyan Kara Group. Based on studies by Gatt, et al (1974) the hydrogeochemical boundary is interpreted to represent a zone of ion exchange favorable for precipitation of uranium. Updip of the boundary, the groundwater is of a calcium sulfate type. Uranium concentrations range from <0.2 to 32 ppB (mean = 13 ppB), calcium concentrations range from 85 to 320 ppB (mean = 158 ppB), and sulfate concentrations range from 600 to 1800 ppM (mean = 708 ppM). Sodium concentrations range from 43 to 363 ppM (mean = 168 ppM) and total alkalinity values range from 130 to 330 ppM (mean = 244 ppM). Downdip of the boundary, the groundwater is of a sodium bicarbonate type. Uranium concentrations range from < 0.2 to 0.54 ppB (mean = .28 ppB), calcium concentrations range from 1.0 to 45 ppB (mean = 8.4 ppB), and sulfate concentrations range from 41 to 1400 ppM (mean = 266 ppM). Sodium concentrations range from 176 to 744 ppM (mean = 296 ppM) and total alkalinity values range from 140 to 920 ppM (mean = 596 ppM). The maximum uranium value observed (32 ppB) occurs near the hydrogeochemical boundary.

29979 **(GJBX—231-81) Baker 1° x 2° NTMS area, Oregon and Idaho: data report (abbreviated).** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). May 1981. Contract AC09-76SR00001. 17p. (DPST—81-146-6). NTIS, PC E03/MF $4.10. Order Number DE81029059.

Includes 9 sheets of 48x reduction microfiche.

Surface sediment samples were collected at 1426 sites, at a target sampling density of one site per 13 square kilometers. Ground water samples were collected at 460 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water and surface water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data from ground water and surface water sites include: (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements, where applicable (water temperature, well description, and scintillometer reading), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). Helium analyses are given for ground water. Data from sediment sites include: (1) stream water chemistry measurements from sites where water was available, and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for these elements; U/Th, U/Hf, U/(Th + Hf), and U/La ratios; and scintillometer readings at sediment sample sites are included on the microfiche. The maximum uranium concentration found in sediments in the Baker quadrangle was 21.1 ppM. The mean of the logarithms of the uranium concentrations was 0.77. Concentrations of uranium and the rare-earth elements were high along the eastern edge of the quadrangle.

29980 **(GJBX—233-81) Raleigh 1° x 2° NTMS area, North Carolina: data report (abbreviated).** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1981. Contract AC09-76SR00001. 18p. (DPST—81-146-9). NTIS, PC E02/MF $3.70. Order Number DE81029064.

Includes 7 sheets of 48x reduction microfiche.

Surface sediment samples were collected at 1199 sites. Surface water samples were collected at 124 of these sites. Ground water samples were collected at 907 sites. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, for uranium and 9 other elements in surface water, and for uranium and 8 other elements in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data from ground water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity); (2) physical measurements where applicable (water temperature, well description, etc.); and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, and V). Data from sediment sites include: (1) stream water chemistry measurements; and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements and for U/Th and U/Hf ratios are included on the microfiche. Key data from stream water sites include (1) water quality measurements; and (2) elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). Uranium concentrations in the sediments range from 0.20 to 237.8 ppM with a mean of 8.93 ppM. The highest uranium concentrations appear to be associated with monazite, as the U/Th ratios are quite low. Higher uranium values in ground water seem to be related to a Triassic basin in the quadrangle.

29981 **(GJBX—234-81) Bluefield 1° x 2° NTMS area, Virginia, and West Virginia: data report (abbreviated).** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 17p. (DPST—81-146-11). NTIS, PC A02/MF A01. Order Number DE81028640.

Surface sediment samples were collected at 886 sites, and surface water samples were collected at 595 of these sites. Ground water samples were collected at 1374 of these sites. Neutron activa-

tion analysis results are given for uranium and 16 other elements in sediments, for uranium and 8 other elements in ground water, and for uranium and 9 other elements in surface water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data from ground water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements, where applicable (water temperature, well description, etc.); and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, and V). Data from sediment sites include (1) stream water chemistry measurements; and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements and for U/Th and U/Hf ratios are included. Key data from stream water sites include (1) water quality measurements; and (2) elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). Uranium concentrations in the sediments that were above detection limits ranged from 0.10 to 27.2 ppM. The mean of the logarithms of the uranium concentrations was 0.53. A series of clusters containing many of the higher uranium values occur across the southern part of the quadrangle. A few of these sites are also high in the U/Th and U/Hf maps. A group of sites in the northwest corner of the quadrangle are high in the U/Th + Hf map.

29982 **(GJBX—235-81) Hydrogeochemical and stream sediment reconnaissance basic data for Charley River Quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Jun 1981. Contract W-7405-ENG-26. 153p. (K/UR—324). NTIS, PC A08/MF A01. Order Number DE81028639.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 1322 water samples from the Charley River Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

29983 **(GJBX—237-81) National Uranium Resource Evaluation. Aerial gamma ray and magnetic survey, Racine and Grand Rapids quadrangles, Michigan, Wisconsin and Illinois. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Jul 1981. Contract AC13-76GJ01664. 320p. NTIS, PC E11/MF $5.30. Order Number DE81028865.

Includes 6 sheets of 48x reduction microfiche.

The Racine and Grand Rapids quadrangles of southeastern Wisconsin, northeastern Illinois, and Michigan cover a land area of 8785 square miles, and an additional water surface area of 5215 square miles. In the northeast, thick Paleozoic deposits overlie a regional downwarp of the Precambrian basement called the Michigan Basin. These Paleozoic deposits shoal to only 500 feet in the southwest corner of the survey area. The entire region is covered by a mantle of Quaternary glacial material. A search of available literature revealed no economically feasible uranium deposits. A total of 83 uranium anomalies were detected and are discussed briefly. All appear to have cultural, and/or locally unsaturated associations, and none appear to contain significant measured quantities of uranium. Magnetic data appear to be in general agreement with existing structural interpretations of the area. There are local exceptions which suggest some lithologic and/or structural complexities in the basement material.

29984 **(GJBX—238-81) National Uranium Resource Evaluation. Aerial gamma ray and magnetic survey, Detroit quandrangle, Michigan. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Jul 1981. Contract AC13-79GJ01692. 266p. NTIS, PC E09/MF $3.90. Order Number DE81028679.

Includes 6 sheets of 48x reduction microfiche.

The Detroit quadrangle covers approximately 7000 square mile area of southeastern Michigan and southern Ontario, Canada within the Midwestern Physiographic Province. The region contains a sequence of Paleozoic sediments that fill the southeastern sector of the Michigan Basin. These are overlain everywhere by Wisconsinan Stage glacial drift and lacustrine sediments. No significant naturally occuring uranium deposits are known to exist in the quadrangle. Radiometric data reflect the complete coverage of bedrock by glacially related sedimentation. Average values are low for potassium, uranium, and thorium. Most anomalies can be assigned to culturally induced sources such as highways and railroads. A grouping of anomalies in the southwest corner of the quadrangle may indicate a somewhat closer association of naturally occurring source elements in this area. No one map unit is responsible for this condition however. The magnetic data agrees well in overall aspect with the structural interpretation of the basement rocks. The edge of the Michigan Basin is well defined with smaller crosscutting structures interrupting the general trend of the magnetic pseudocontours.

29985 **(GJBX—239-81) National Uranium Resource Evaluation. Aerial gamma ray and magnetic survey, Tawas City and Flint quadrangles, Michigan. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Jul 1981. Contract AC13-76GJ01664. 312p. NTIS, PC E11/MF $4.50. Order Number DE81028863.

Includes 8 sheets of 48x reduction microfiche.

The Tawas City and Flint quadrangles of Michigan cover a land area of 6500 square miles, and an additional water surface area of 7200 square miles. Extremely thick Paleozoic deposits overlie a regional downwarp of the Precambrian basement called the Michigan Basin. These Paleozoic deposits shoal to only 1500 feet in the northeast corner. The entire survey area is covered by a mantle of Quaternary glacial material. A search of available literature revealed no economically feasible uranium deposits. Thirty-five uranium anomalies were detected and are discussed briefly. All appear to have cultural, and/or locally unsaturated associations, and none appear to contain significant measured quantities of uranium. Magnetic data appear to be in good agreement with existing structural interpretations of the area.

29986 **(GJBX—240-81) Airborne gamma-ray spectrometer and magnetometer survey, Crescent quadrangle (Oregon). Volume II. Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1981. Contract AC13-79GJ01692. 184p. NTIS, PC A09/MF A01. Order Number DE81028662.

Seventeen uranium anomalies meet the minimum statistical requirements as defined in Volume I. These anomalies are listed and are shown on the Uranium Anomaly Interpretation Map. Potassium (%K), equivalent Uranium (ppM eU), equivalent Thorium (ppM eT), eU/eT, eU/K, eT/K, and magnetic Pseudo Contour Maps are presented in Appendix E. Stacked Profiles showing geologic strip maps along each flight-line, together with sensor data, and ancillary data are presented in Appendix F. All maps and profiles were prepared on a scale of 1:250,000, but have been reduced to 1:500,000 for presentation in Volume II. Anomaly No. 1 is over Pliocene-Pleistocene basalt and andesite (Qtba). Anomaly No. 2 is over the contact zone between rhyolitic rocks of the John Day formation (Tmor) and Quaternary alluvium (Qal). Anomaly No. 3 is over the contact area between Tertiary silicic ash-flow tuff (Tat) and Quaternary alluvium (Qal). Anomalies No. 4, No. 5, No. 6 are over Recent pumice and ash-flow deposits (Qrp). Anomalies No. 7, No. 8, No. 9, and No. 10 are over Pliocene/Pleistocene basalt (Qtb). Anomaly No. 11 is over the contact area between Pliocene basalt (Tpb), and Pliocene/Pleistocene basalt (Qtb). Anomaly No. 12 is over Quaternary terrace deposits (Qpn). Anomalies No. 13, and No. 14 are over Pleistocene basalt (Tpb). Anomaly No. 15 is over tuffaceous sedimentary rocks (Ts). Anomaly No. 16, the largest in the quadrangle, is over tuffaceous sedimentary rocks (Ts), dune sands (Qd), silicic vent rocks (Tvs), and Quaternary lacustrine rocks (Q1). Anomaly No. 17 is over silicic vent rocks and Quaternary lacustrine sediments (Q1).

29987 **(GJBX—240-81Vol.2(BendQ)) Airborne gamma-ray spectrometer and magnetometer survey, Bend quadrangle (Oregon). Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1981. Contract AC13-79GJ01692. 214p. NTIS, PC A10/MF A01. Order Number DE81028680.

Eight uranium anomalies meet the minimum statistical requirements as defined in Volume I. These anomalies are listed and are shown on the Uranium Anomaly Interpretation Map. Potassim

(%K), equivalent Uranium (ppM eU), equivalent Thorium (ppM eT), eU/eT, eU/K, eT/K, and Magnetic Pseudo Contour Maps are presented in Appendix E. Stacked Profiles showing geologic strip maps along each flight-line, together with sensor data, and ancillary data are presented in Appendix F. All maps and profiles were prepared on a scale of 1:250,000, but have been reduced to 1:500,000 for presentation in Volume II.

29988 **(GJBX—240-81Vol.2(CanyonCityQ)) Airborne gamma-ray spectrometer and magnetometer survey. Canyon City quadrangle (Oregon). Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1981. Contract AC13-79GJ01692. 212p. NTIS, PC A10/MF A01. Order Number DE81028682.

Fourteen uranium anomalies meet the minimum statistical requirements as defined in Volume I. These anomalies are listed and are shown on the Uranium Anomaly Interpretation Map. Potassium (%K), equivalent Uranium (ppM eU), equivalent Thorium (eT), eU/eT, eU/K, eT/K, and Magnetic Pseudo Contour Maps are presented in Appendix E. Stacked Profiles showing geologic strip maps along each flight-line, together with sensor data, and ancillary data are presented in Appendix F. All maps and profiles were prepared on a scale of 1:250,000, but have been reduced to 1:500,000 for presentation in Volume II. Anomaly No. 1 is over mainly sedimentary rocks of undifferentitatd Paleozoic/Mesozoic age (MzPza). Anomaly No. 2 is over a fault contact between Strawberry volcanics (Ts), and volcanic rocks of the Clarno (Tc). Anomaly No. 3 is over an intensely faulted block of Strawberry volcanics (Ts). Anomaly No. 4 is over the contact area between Strawberry volcanic rocks (Ts) and a basalt plug of Tertiary age (Tbi). Anomaly No. 5 is over the contact area between volcanic rocks of the Clarno formation (Tc) and undivided sedimentary rocks of Jurassic/Triassic age. Part of the anomaly is over landslide debris (Ql). Anomalies No. 6 and No. 7 are over a fault contact between volcanic rocks of the Clarno formation (Tc) and undivided sedimentary rocks of Jurassic/Triassic age (JTru).

29989 **(GJBX—240-81Vol.2(SalemQ)) Airborne gamma-ray spectrometer and magnetometer survey, Salem quadrangle (Oregon). Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1981. Contract AC13-79GJ01692. 126p. NTIS, PC A07/MF A01. Order Number DE81028681.

Five uranium anomalies meet the minimum statistical requirements as defined in Volume I. These anomalies are tabulated and are shown on the Uranium Anomaly Interpretation Map. Potassium (%K), equivalent Uranium (ppM eU), equivalent Thorium (eT), eU/eT, eU/K, eT/K, and magnetic pseudo-contour maps are presented in Appendix E. Stacked Profiles showing geologic strip maps along each flight-line, together with sensor data, and ancillary data are presented in Appendix F. All maps and profiles were prepared on a scale of 1:250,000, but have been reduced to 1:500,000 for presentation in Volume II. Each of the anomalies occurs over the Eocene Tyee and Burpee formation (Teme), a rhythmically banded, feldspathic and micaceous, massive bedded sandstone, and siltstone. Anomalies 1, 2, 3, and 4 are in the northwest corner of the map. Anomalies 2 and 3 are near faults, so may be due to radon leaking from the faults. Anomaly No. 5 is in the southwest corner of the map.

29990 **(GJBX—241-81Vol.2A) Airborne gamma-ray spectrometer and magnetometer survey, Peoria quadrangle (IL). Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1981. Contract AC13-79GJ01692. 164p. NTIS, PC A08/MF A01. Order Number DE81028862.

Twenty-three uranium anomalies meet the minimum statistical requirements as defined in Volume I. These anomalies are listed and are shown on the Uranium Anomaly Interpretation Map. Potassium (%K), equivalent Uranium (ppM eU), equivalent Thorium (ppM eTh), eU/eTh, eU/K, eTh/K, and magnetic pseudo-contour maps are presented in Appendix E. Stacked Profiles showing geologic strip maps along each flight-line, together with sensor data, and ancillary data are presented in Appendix F. All maps and profiles were prepared on a scale of 1:250,000, but have been reduced to 1:500,000 for presentation in Volume II. Anomalies No. 1 and No. 2, and No. 19 are over areas underlain by the Radnor Till member (Qti) of the Pleistocene Glasford formation. Anomalies No. 3 and No. 5 are over areas underlain by Pleistocene moraine and other deposits of the Fairgrange Till member (Qwf, Qwfm) of the Wedron formation. Anomaly No. 4 is over an area underlain by the Pleistocene Batestown Till member (Qwb) of the Wedron formation. Anomalies No. 6 and No. 7 are over areas underlain by the Delavan Till member (Qwd) of the Pleistocene Wedron formation. Anomalies No. 8 and No. 20 are over areas underlain by Pleistocene moraine deposits of the Yorkville Till member (Qwym) of the Wedron formation. Anomalies No. 9, No. 12, and No. 14 are over areas underlain by Pleistocene moraine deposits of the Snider Till member (Qwsm) of the Wedron formation. Anomalies No. 10, and No. 15 to No. 16 are over areas underlain by the Snider Till member (Qws) of the Wedron formation of Pleistocene age. Anomaly No. 11 is over an area underlain by the Pleistocene Snider Till member (Qws) of the Wedron formation and Cahokia Alluvium (Qc).

29991 **(GJBX—241-81Vol.2B) Airborne gamma-ray spectrometer and magnetometer survey, Belleville quadrangle (IL). Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1981. Contract AC13-79GJ01692. 151p. NTIS, PC A08/MF A01. Order Number DE81028861.

Forty-two uranium anomalies meet the minimum statistical requirements as defined in Volume I. These anomalies are listed and are shown on the Uranium Anomaly Interpretation Map. Potassium (%K), equivalent Uranium (ppM eU), equivalent Thorium (ppM eTh), eU/eTh, eU/K, eTh/K, and magnetic pseudo-contour maps are presented in Appendix E. Stacked Profiles showing geologic strip maps along each flight-line, together with sensor data, and ancillary data are presented in Appendix F. All maps and profiles were prepared on a scale of 1:250,000, but have been reduced to 1:500,000 for presentation in Volume II. Anomalies No. 1, No. 4 to No. 17, No. 22 to No. 23, and No. 27 to No. 30 are over areas underlain by the Radnor Till member (Qti) of the Pleistocene Glasford formation. Anomalies No. 2 and No. 3 are over areas underlain by Pleistocene Cahokia Alluvium (Qc) and the Radnor Till member (Qti) of the Glasford formation. Anomalies No. 18 to No. 21, and No. 24 are over areas underlain by the Pleistocene Equality formation (Qcl). Anomalies No. 25 and No. 26 are over areas underlain by the Equality formation (Qcl) and the Radnor Till member (Qti) of the Glasford formation. Both of these formations are of Pleistocene age. Anomalies No. 31 and No. 33 are over areas underlain by the Pleistocene Cahokia Alluvium (Qc). Anomalies No. 32, No. 34 to No. 38, and No. 40 to No. 42 are over areas underlain by the Radnor Till member (Qti) of the Pleistocene Glasford formation. Anomaly No. 39 is over an area underlain by the Radnor Till (Qti) and the Hagarstown (Qgh) members of the Pleistocene Glasford formation.

29992 **(GJBX—241-81Vol.2C) Airborne gamma-ray spectrometer and magnetometer survey, Decater quadrangle (IL). Final report.** (High Life Helicopters, Inc., Puyallup, WA (USA); QEB, Inc., Lakewood, CO (USA)). 1981. Contract AC13-79GJ01692. 165p. NTIS, PC A08/MF A01. Order Number DE81028860.

Thirty-eight uranium anomalies meet the minimum statistical requirements as defined in Volume I. These anomalies are listed and are shown on the Uranium Anomaly Interpretation Map. Potassium (%K), equivalent Uranium (ppM eU), equivalent Thorium (ppM eTh), eU/eTh, eU/K, eTh/K, and magnetic pseudo-contour maps are presented in Appendix F. All maps and profiles were prepared on a scale of 1:250,000, but have been reduced to 1:500,000 for presentation in Volume II.

29993 **(GJBX—244-81) Hydrogeochemical and stream sediment reconnaissance basic data for Douglas quadrangle, Arizona; New Mexico.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 May 1981. Contract W-7405-ENG-26. 86p. (K/UR—315). NTIS, PC E04/MF A01. Order Number DE81028081.

Includes 2 sheets of 48x reduction microfiche.

Field and laboratory data are presented for 161 water samples and 235 sediment samples from the Douglas Quadrangle, Ari-

zona; New Mexico. Uranium values have been reported by Los Alamos National Laboratory in Report GJBX-69(78). The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

29994 **(GJBX—245-81) Hydrogeochemical and stream sediment reconnaissance basic data for Point Hope quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 May 1981. Contract W-7405-ENG-26. 70p. (K/UR—333). NTIS, PC E03/MF A01. Order Number DE81028167.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 211 water samples from the Point Hope Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

29995 **(GJBX—246-81) Hydrogeochemical and stream sediment reconnaissance basic data for Beechey Point Quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Jun 1981. Contract W-7405-ENG-26. 71p. (K/UR—338). NTIS, PC E03/MF A01. Order Number DE81028168.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presnted for 214 water samples from the Beechey Point Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

29996 **(GJBX—247-81) Hydrogeochemical and stream sediment reconnaissance basic data for Meade River quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Jun 1981. Contract W-7405-ENG-26. 95p. (K/UR—342). NTIS, PC 304/MF A01. Order Number DE81027407.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 515 water samples from the Meade River Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

29997 **(GJBX—248-81) Hydrogeochemical and stream sediment reconnaissance basic data for Teshekpuk quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Jun 1981. Contract W-7405-ENG-26. 91p. (K/UR—346). NTIS, PC E04/MF A01. Order Number DE81027408.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 479 water samples from the Teshekpuk Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

29998 **(GJBX—249-81) Hydrogeochemical and stream sediment reconnaissance basic data for Umiat quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Jun 1981. Contract W-7405-ENG-26. 92p. (K/UR—347). NTIS, PC E04/MF A01. Order Number DE81027423.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 482 water samples from the Umiat Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

29999 **(GJBX—252-81) Hydrogeochemical and stream sediment reconnaissance basic data for Harrison Bay quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Jun 1981. Contract W-7405-ENG-26. 78p. (K/UR—359). NTIS, PC E04/MF A01. Order Number DE81028352.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 328 water samples from the Harrison Bay Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

30000 **(GJBX—21381) Gadsden and Tupelo 1^0 x 2^0 NTMS areas, Alabama: data report (abbreviated).** Bennett, C.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1981. Contract AC09-76SR00001. 17p. (DPST—81-146-1). NTIS, PC E03/MF $5.10. Order Number DE81027986.

Includes 14 sheets of 24x reduction microfiche.

Sediment samples were collected at 776 and 69 sites in the Gadsden and Tupelo quadrangles, respectively. Ground water samples were collected at 1416 and 116 sites in the Gadsden and Tupelo quadrangles, respectively. Stream water samples were collected at 673 and 68 sites in the Gadsden and Tupelo quadrangles, respectively. Neutron activation analyses results are given for uranium and 16 other elements in sediments, and for uranium and 8 other elements in ground water and stream water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data from ground water and stream water sites include: (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements where applicable (water temperature, well description, etc.), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, V, and, when available, He). Areal distribution maps, histograms, and cumulative frequency plots for these elements and measurements for ground water and stream water in the Gadsden quadrangle are included. Data from sediment sites include: (1) stream water chemistry measurements (pH, conductivity, and alkalinity), and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for these elements and measurements for stream sediments in the Gadsden quadrangle are included on microfiche. Uranium concentrations in the sediments ranged from 0.3 to 27.3 ppM with an average of 3.26. Uranium concentrations in ground water samples ranged from 0.006 to 01.1 ppB with an average of 0.235. Uranium concentrations in stream water samples ranged from 0.006 to 22.88 ppB with an average of 0.193.

30001 **(GJQ—011-81) National Uranium Resource Evaluation: Durango Quadrangle, Colorado.** Theis, N.J.; Madson, M.E.; Rosenlund, G.C.; Reinhart, W.R.; Gardner, H.A. (Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). Jun 1981. Contract AC13-76GJ01664. 145p. NTIS, PC E06/MF $4.30. Order Number DE81028162.

Includes 9 sheets of 24 reduction microfiche.

The Durango Quadrangle (2^0), Colorado, was evaluated using National Uranium Resource Evaluation criteria to determine environments favorable for uranium deposits. General reconnaissance, geologic and radiometric investigations, was augmented by detailed surface examination and radiometric and geochemical studies in selected areas. Eight areas favorable for uranium deposits were delineated. Favorable geologic environments include roscoelite-type vanadium-uranium deposits in the Placerville and Barlow Creek-Hermosa Creek districts, sandstone uranium deposits along Hermosa Creek, and vein uranium deposits in the Precambrian rocks of the Needle Mountains area and in the Paleozoic rocks of the Tuckerville and Piedra River Canyon areas. The major portions of the San Juan volcanic field, the San Juan Basin, and the San Luis Basin within the quadrangle were judged unfavorable. Due to lack of information, the roscoelite belt below 1000 ft (300 m), the Eolus Granite below 0.5 mi (0.8 km), and the Lake City caldera are unevaluated. The Precambrian Y melasyenite of Ute Creek and the Animas Formation within the Southern Ute Indian Reservation are unevaluated due to lack of access.

30002 **(K/UR—326) Hydrogeochemical and stream sediment reconnaissance basic data for McCarthy Quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 29 May 1981. Contract W-7405-ENG-26. 111p. NTIS, PC A06/MF A01. Order Number DE81028671.

Field and laboratory data are presented for 766 water samples from the McCarthy Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

30003 **(K/UR—335) Hydrogeochemical and stream sediment reconnaissance basic data for Point Lay Quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Jun 1981. Contract W-7405-ENG-26. 75p. NTIS, PC A04/MF A01. Order Number DE81028669.

Field and laboratory data are presented for 219 water samples from the Point Lay Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the uranium Resource Evaluation Project at Oak Ridge, Tennessee.

30004 **(K/UR—336) Hydrogeochemical and stream sediment reconnaissance basic data for Wainwright Quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Jun 1981. Contract W-7405-ENG-26. 80p. NTIS, PC A05/MF A01. Order Number DE81028670.

Field and laboratory data are presented for 293 water samples from the Wainwright Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Union Resource Evaluation Project at Oak Ridge, Tennessee.

0503 Mining

REFER ALSO TO CITATION(S) 29906

0504 Feed Processing

REFER ALSO TO CITATION(S) 31024

30005 **(GJBX—212-81) Recovery of uranium from seawater.** Best, F.R.; Driscoll, M.J. (eds.). (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Dec 1980. Contract AC13-76GJ01664. 310p. (CONF-801229—). NTIS, PC A14/MF A01. Order Number DE81027989.

From Topical meeting: the recovery of uranium from sea water; Cambridge, MA, USA (1 Dec 1980).

This report is the proceedings of a topical meeting on the recovery of uranium from seawater, held at the Massachusetts Institute of Technology on December 1-2, 1980. The meeting was sponsored by the United States Department of Energy and hosted by the MIT Energy Laboratory and Nuclear Engineering Department. Workers from six different countries presented a total of sixteen papers in three major categories: the state-of-the-art resulting from past efforts; detailed results from sorber preparation and performance experiments; and overall system design aspects. Sorbers discussed include hydrous titanium oxide, ion exchange resins, chitosan, humic acids and activated carbon. Systems for contacting seawater with the sorber include actively pumped, current and wave-powered concepts. Filter configurations include thin multilayer stacks, fluidized beds and free falling particles. Several of the researchers estimated eventual production costs in the 200 to 400 $/lb U_3O_8 range, although values as high as 2000 $/lb were also quoted. The bulk of the proceedings is comprised of the unedited papers, as provided by the authors. The proceedings also include edited transcripts of the discussions on all papers and the panel and concluding discussions. All papers have been abstracted separately.

30006 (GJBX—212-81, pp 26U-34U) **Feasibility study of uranium extraction from seawater: a summary.** Campbell, M.H. (Exxon Nuclear Co., Inc., Richland, WA); Binney, S.E. Dec 1980. NTIS, PC A14/MF A01.

From Topical meeting: the recovery of uranium from sea water; Cambridge, MA, USA (1 Dec 1980).

Feasibility of uranium recovery has four readily definable sub-divisions: (1) technical feasibility; (2) engineering feasibility; (3) economic feasibility; and (4) social feasibility. It was found in this study that it would be technically feasible to recover uranium from seawater, although there are a number of site-specific studies that should be conducted prior to site selection. It is not feasible from an engineering viewpoint to go beyond the preliminary conceptual design for a pumped flow system without conducting further studies. It would be socially feasible to recover uranium from the seawater as long as the plant site were in a low population area. Without several major technical breakthroughs leading to significantly lower production costs and/or federal subsidy, a pumped seawater plant to extract uranium from seawater is not economically feasible at the present time.

30007 (GJBX—212-81, pp 47U-57U) **Adsorption and elution of uranium in seawater.** Kanno, M. (Univ. of Tokyo, Japan). Dec 1980. NTIS, PC A14/MF A01.

From Topical meeting: the recovery of uranium from sea water; Cambridge, MA, USA (1 Dec 1980).

In Japan, the essentiality of the development of nuclear power generation has become enhanced, and it needs to ensure uranium resources mainly from foreign countries. Though several policies have been taken, extraction of uranium from seawater has been interesting, and some investigations have been carried out mainly by the Metal Mining Agency of Japan since 1975. In this program, selections of chemical processes, adsorption tests mainly with hydrous titanium oxide, elution processes, washing processes, the recovery of eluate by steam stripping or electrodialysis, secondary concentrations of uranium in the eluate by ion exchange or ion flotation, etc., and some tentative cost estimations have been carried out. Some results of the experiments for each unit process will be described.

30008 (GJBX—212-81, pp 59U-71U) **Studies on complexing resins accumulating uranium from seawater.** Schwochau, K.; Astheimer, L.; Schenk, H.J.; Witte, E.G. (Nuclear Research Centre (KFA), Juelich, Germany). Dec 1980. NTIS, PC A14/MF A01.

From Topical meeting: the recovery of uranium from sea water; Cambridge, MA, USA (1 Dec 1980).

Resins containing suitable functional groups are capable of concentrating uranium from sea water, and in comparison with hydrous titanium oxide resins can present some advantages such as higher uranium loading, more selectivity, and higher stability against sea water.

30009 (GJBX—212-81, pp 71U-80U) **Specific uranyl binding by macrocyclic ligands attached to resins.** Tabushi, I.; Kobuke, Y. (Kyoto Univ., Japan). Dec 1980. NTIS, PC A14/MF A01.

From Topical meeting: the recovery of uranium from sea water; Cambridge, MA, USA (1 Dec 1980).

Macrocyclic polydentates have attracted enormous attention from chemists because of their unique and significant characteristics of the strong and selective binding of a variety of metal ions. The metal binding is governed mostly by the size of the macroring and the nature of heteroatoms involved. The most important role of the macrocyclic structure is, in general, the so-called macrocyclic effect - to increase (making less negative) a large negative entropy change involved in the polydentate chelation. Basic strategy of uranium binding, is to design a ligand of very strong metal binding to take advantage of this macrocyclic effect, where number of chelating heteroatoms and their spatial arrangement is designed to be most appropriate for uranyl (UO_2^{2+}) binding, since in natural sea water uranium is dissolved mostly in a form of uranyl carbonate. The following macrocylic ligands, hexamine, hexaketone, hexacarboxylic acid, were prepared and tested. The macrocyclic hexacarboxylic ligand was the most promising. The addition of hexacarboxylic acid to a uranyl tricarbonate solution gave a change of visible absorption due to the competitive formation of the uranyl complex. From this competitive binding, a relative formation constant was estimated to be 10^{-5}, giving a log K/sub f/ value of 16.4 at 25°C for the uranyl complex. This value is the largest among the hosts ever reported to bind uranyl ion.The selectivity of the macrocyclic hexacarboxylic ligand was also ascertained by testing with other metal cations. Results indicate that uranyl ions can be extracted efficiently from sea water using the hexacarboxylic acid ligands which are attached to a polymer insoluble in water.

30010 (GJBX—212-81, pp 82U-92U) **Convenient laboratory screening test for potential sorbers of uranium from seawater.** Maroldo, S.G. (Rohm and Haas, Spring House, PA); Beasley, G.H. Dec 1980. NTIS, PC A14/MF A01.

From Topical meeting: the recovery of uranium from sea water; Cambridge, MA, USA (1 Dec 1980).

Progress on a convenient method for measuring the sorption pseudoisotherm of uranium from natural or synthetic seawater with experimental sorbers is described. This permits comparisons of the performances of different experimental sorbents. Solutions were analyzed using laser induced fluorescence.

30011 (GJBX—212-81, pp 96U-121U) **Advantage of fast reacting adsorbents like humic acids for the recovery of uranium from seawater.** Denzinger, H. (Dornier System GmbH, Friedrichshafen, Germany); Schnell, C.; Heitkamp, D.; Wagener, K. Dec 1980. NTIS, PC A14/MF A01.

In Recovery of uranium from seawater.

This report is divided into two sections. The first part comprises experimental data of humic acid adsorbers; whereas, the second concerns design parameter and costs of a recovery plant using fast reacting adsorbents. Summarizing the experimental results, hydrogen-loaded humic acids on carriers show an exceptionally fast kinetics of uranium fixation in seawater which is practically temperature independent. This fast adsorption performance may be maintained in a technical recovery process if care is taken to minimize slow diffraction controlled steps preceding the uranium fixation reaction. When humic acid was used instead of titanium hydroxide in the recovery plant, there was a decrease of investment and production costs of about 50%. However, there was a higher percentage of energy costs, i.e., electric power consumption and investments for pumps.

30012 (GJBX—212-81, pp 124U-134U) **Recovery of uranium from sea water by chelation on chitosan.** Muzzarelli, R.A.A.; Tanfani, F.; Mariotti, S. (Univ. of Ancona, Italy). Dec 1980. NTIS, PC A14/MF A01.

In Recovery of uranium from seawater.

The results presented for the best chitosans (scarcely acetylated polymers of glucosamine) available implement and confirm the authors' early results obtained twelve years ago. In view of its selectivity (indifference to alkali and alkali-earth elements) and its hydrophilicity, chitosan is quite suitable for the recovery of uranium from water and NaCl brine, thus it will certainly be applicable for the recovery of naturally occurring uranium from sea water.

30013 (GJBX—212-81, pp 149U-164U) **Recovery of uranium from seawater.** Kanno, M. (Univ. of Tokyo, Bunkyo-ku, Japan); Saito, K. (Univ. of Tokyo, Bynkyo-ku, Japan). Dec 1980. NTIS, PC A14/MF A01.

From Topical meeting: the recovery of uranium from sea water; Cambridge, MA, USA (1 Dec 1980).

Japan depends on foreign countries for most of her energy resources. Therefore, nuclear power generation is considered to be very important, but known domestic uranium resources are very rare. Hence, recovery of uranium from seawater has become of interest. To investigate the technical and economical feasibility of recovering uranium from seawater, a research program has been carried out in the Metal Mining Agency of Japan, since 1975, sponsored by the Ministry of International Trade and Industry. In this program, selections of the chemical processes, developments of adsorbents mainly on hydrous titanium oxide, the performance of continuous adsorption and elution process, the recovery of eluate by steam stripping or electodialysis, secondary concentrations of uranium in the eluate by ion exchange or ion flotation etc., some site selections around Japanese coast, the conceptional designs of two types of commercial plants, the pumping and fixed bed type and the direct sea current utilization type, and some tentative cost estimations have been carried out. Though several problems await solution, it has shown that it is technically feasible. Accordingly, the construction of a model plant with a uranium production capacity of about 10 kg/year will be started in October 1980.

30014 (GJBX—212-81, pp 168U-196U) **UEB concept of uranium extraction from seawater.** Bitte, J.; Fremery, M.I.; Bals, H.G. (URANERZBERGBAU-GmbH, Bonn, Germany). Dec 1980. NTIS, PC A14/MF A01.

From Topical meeting: the recovery of uranium from sea water; Cambridge, MA, USA (1 Dec 1980).

The UEB-concept, a semi-) submersible current driven adsorption unit using fluidized adsorber beds with hydrous titanium oxide (HTO) is introduced. Based on the properties of the HTO adsorber, a design is described for the complete chemical process involved in the extraction of U_3O_8 from seawater. A technically feasible procedure to manufacture the adsorber is also given.

30015 (GJBX—212-81, pp 200U-241U) **Recovery of uranium from seawater by using wave power and floating offshore units.** Bjoerk, B.; Vallander, P. (VBB, Stockholm, Sweden). Dec 1980. NTIS, PC A14/MF A01.

From Topical meeting: the recovery of uranium from sea water; Cambridge, MA, USA (1 Dec 1980).

In the present project, the feasibility of a floating unit for the recovery of uranium from seawater is studied. The seawater is supplied to the adsorbent inside the unit by means of wave energy. The wave energy transformation method derives from a Swedish patent, and is based on the principle that waves will rush up on a sloping plane, which is partly submerged in the water, and fill a reservoir with seawater to a level which is higher that the still water level in the sea. This difference in water level will create a pressure head which can be utilized to force seawater through filter beds. A processing plant on land and build up of adsorbent beds are not included in this study. The areas of investigation are: waves, streams and water temperatures available at sea; uranium uptake; optimization of a plant; conceptual layout of a floating unit; dynamic response of a floating unit; and costs. The chemical process for the separation of uranium from seawater can be divided into four operations. (1) Direct loading of the adsorbent with seawater. The operation is stopped when the adsorbent uptake capacity is reached. The adsorbent will then be prewashed with fresh water. (2) Eluation of the adsorbent with an eluant (ammonium carbonate). The adsorbent will then be postwashed with freshwater. (3) Steam stripping of the eluate to extract the uranium and to recover the eluant for reuse. (4) Preparation of the solid uranium product by filtration and use of ion exchangers.

30016 (GJBX—212-81, pp 243U-262U) **Lawrence Livermore Laboratory concept for uranium recovery from seawater.** Gregg, D.; Wang, F. (Lawrence Livermore National Lab., CA). Dec 1980. NTIS, PC A14/MF A01.

From Topical meeting: the recovery of uranium from sea water; Cambridge, MA, USA (1 Dec 1980).

The Lawrence Livermore Laboratory concept for uranium recovery from seawater involves the following process steps: (1) produce activated carbon via a coal gasification plant; (2) contact activated carbon sorbent with seawater using a settling process (no pumping of seawater); (3) vacuum activated carbon from sea floor; (4) gasify or burn activated carbon (further concentrating the uranium in the ash); (5) extract the uranium from the rich ash ore by conventional techniques. The process advantages are: (1) eliminates seawater pumping, the need for an illuent, and the need for a fresh water wash; (2) should result in much lower capital investment and regional process energy. Major process issues are: (1) uranium loading on activated carbon; (2) activated carbon modifications required to improve the sorbtion performance; (3) activated carbon particle size needed to meet system requirements; (4) minimization of sorbent losses when contacted with seawater.

30017 (GJBX—212-81, pp 265U-278U) **Practical constraints on systems for the extraction of uranium from seawater.** Driscoll, M.J.; Whaley, J.L.; Nitta, C.K.; Best, F.R. (Massachusetts Inst. of Tech., Cambridge). Dec 1980. NTIS, PC A14/MF A01.

From Topical meeting: the recovery of uranium from sea water; Cambridge, MA, USA (1 Dec 1980).

As of now there is no general agreed upon overall conceptual system design for a practical uranium-from-the-sea facility. Elementary considerations suggest that the design envelope of acceptable parameters severely restricts the available options. More work is clearly in order, but it would appear that a viable system must employ absorber particles of small dimensions, in thin beds of high void fraction, most likely sited at sea. It would also appear that considerable useful input in the formulation of a design approach could be gained by closer attention to research in progress on other

energy options. For example, the high-capacity, low-head axial flow pumps under consideration for OTEC units are also ideal for sea-borne uranium facilities; and, in the area of passive systems, one should note that the kelp farm biomass concept shares many similar problems, including current-driven nutrient transport. Preliminary conceptual designs of active and passive units for the recovery of uranium from seawater have been produced which may have the potential of meeting the requirements established. They will be used as the starting point for further work on system design in the DOE-sponsored project on uranium extraction from seawater at MIT.

0505 Enrichment

REFER ALSO TO CITATION(S) 31092

30018 **(LA-tr—81-16) Gas centrifugal separator.** Kanda, Y. (Los Alamos National Lab., NM (USA)). Jul 1981. Translation of . Japanese Patent 1979-39,779. 4p. NTIS, PC A02/MF A01. Order Number DE81027617.

A very brief description is given of a gas centrifugal separator which separates a gas into a heavy gas and a light gas, and has a thermoelectric element for cooling the heavy gas collecting tube. (DLC)

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 31069

30019 **Fabrication of thorium bearing carbide fuels.** Gutierrez, R.L.; Herbst, R.J.; Johnson, K.W. (to Department of Energy). US Patent 4,261,935. 14 Apr 1981. Filed date 20 Nov 1979. vp.

PAT-APPL-096261.

Thorium-uranium carbide and thorium-plutonium carbide fuel pellets have been fabricated by the carbothermic reduction process. Temperatures of 1750°C. And 2000°C. Were used during the reduction cycle. Sintering temperatures of 1800* C. And 2000* C. Were used to prepare fuel pellet densities of 87% >94% of theoretical, respectively. The process allows the fabrication of kilogram quantities of fuel with good reproducibility of chemicals and phase composition. Methods employing liquid techniques that form carbide microspheres or alloying-techniques which form alloys of thorium-uranium or thorium-plutonium suffer from limitation on the quantities processed of because of criticality concerns and lack of precise control of process conditions, respectively.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 30031, 30060, 30693, 31025

30020 **(DP-MS—81-15) Study of the formation, prevention, and recovery of plutonium from plutonium esters in the Purex process.** Gray, L.W.; Burney, G.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 8p. (CONF-810813—11). NTIS, PC A02/MF A01. Order Number DE81027943.

From National American Chemical Society summer meeting; New York, NY, USA (23 Aug 1981).

The Savannah River Plant uses the basic Purex process to separate ^{239}Pu from ^{238}U and fission products. Dark-brown, dense solids containing up to 30% Pu have previously occurred in rotameters in the plutonium finishing operations. The kinetics of formation of this mixture of DBP- and MBP-Pu esters suggest two methods to prevent the formation of the solids. A selective dissolution method using NaOH metathesis has been developed to separate the phosphate ester from the plutonium before dissolution of the residual plutonium hydroxide in a HNO_3-HF medium.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 30033, 31081

30021 **(DOE/NV/10061—8) Commercial waste and spent fuel packaging program. Quarterly report, April-June 1981.** Hakl, A.R. (Westinghouse Electric Corp., Mercury, NV (USA). Advanced Energy Systems Div.). 1981. Contract AC08-80NV10061. 13p. NTIS, PC A02/MF A01. Order Number DE81028245.

This document is a report of activities performed by Westinghouse Advanced Energy Systems Division - Nevada Operations at the E-MAD Facility, Area 25, Nevada Test Site, in meeting subtask objectives during the third quarter of Fiscal Year 1981. These activities include: completion of installation of the Constant Air Monitor (CAM) and Remote Area Monitor (RAM) Systems; and publication of their procedures; installation of Hot Bay Pit Adapters; Plasma Arc Welder development, including evaluation of test welds; receipt of the Evacuation/Backfill Collar; completion of testing for evaluation of Drywell moisture accumulation; and revision of the Safety Assessment Document, NVO-198, to include High Level Waste (HLW) log handling.

30022 **(HEDL-TME—80-84) Assessment of spent-fuel structural integrity under disposal-cycle conditions.** Bosi, D.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1981. Contract AC14-76FF02170. 102p. NTIS, PC A06/MF A01. Order Number DE81028634.

The fatigue-fracture integrity of spent light water reactor fuel assemblies under disposal cycle dynamic loadings is assessed. The scope of the analyses covers the response of intact Zircaloy clad fuel assemblies in both shipping cask and gaseous stabilized canister configurations. Peak bedrock accelerations were applied as the seismic loading. Transportation loads in the form of peak normal shock loading were also applied to the fuel assembly dynamic models. Transportation or fuel assembly drop accidents were not considered in the analyses. Finite element techniques solved the structural dynamics phase of the analyses, and influence coefficient methods were employed to assess the cladding fatigue crack growth or fracture. Results of the analyses show that spent fuel cladding, even with assumed large flaws, has fatigue-fracture integrity well in excess of the disposal cycle dynamic response loads. The report concludes that mechanically induced fatigue crack propagation is an insignificant spent fuel degradation mechanism during the initial 1000-year disposal period. 40 figures, 16 tables.

0510 Marketing And Economics

REFER ALSO TO CITATION(S) 29946

0520 Waste Management

REFER ALSO TO CITATION(S) 30021, 30022, 30050, 30051, 30052, 30074, 30560, 30943, 31003, 31003, 31027, 31037, 31038, 31039, 31040, 31057, 31311, 31317

30023 **(ORNL-tr—4775) Storage and solidification of LAW/MAW in underground caverns: Phase 2. Semiannual report, January 1, 1980-June 30, 1980.** (Oak Ridge National Lab., TN (USA)). [nd]. Translation of FUE-80030, 31 July 1980. 32p. NTIS, PC A03/MF A01. Order Number DE81029093.

This report covers three areas: quality assurance, ventilation systems, and product conveyance, for the purpose of obtaining data necessary for a large-scale test. The work done on quality assurance is divided into two parts: Model Experiment on Storage of the Product, and Methods of Underground Control. The goals for part one are to investigate: heat generation during storage; influence of the rock on the boundary zones; interactions between product and rock; separation processes; and bulk porosity and angle of repose formation. The goal for part two is to determine underground operational parameters with the aid of measuring methods which satisfy the demands in the cavern so as to guarantee monitoring of the installation and the product. The purpose of the cavern ventilation

system is to guarantee the safe confinement of the radwaste stored in the cavern. This includes the safe transport, conveyance and purification of the air required for ventilation and exhaust. Studies are conducted in the following two areas: simulation of convection and material exchange processes, and design of the ventilation system. The goal for the research on conveyance of the product is to determine the characteristic rheological data for the reference product as a basis for designing the conveyance system. Results to date and outlook for all of these projects are presented.

30024 **(CONF-810733—1) Low-level radioactive waste: an introductory overview.** Godbee, H.W.; Kibbey, A.H. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01. Order Number DE81026334.

From ASME short course on radioactive waste management for nuclear power reactors and other facilities; Alexandria, VA, USA (13 Jul 1981).

In 1980, the accumulated volume of buried low-level waste (LLW) in the United States amounted to over 92,000 m^3. Of this, 49,700 m^3 was attributed to the US commercial fuel cycle, 36,400 m^3 to institutional and industrial, and 76,300 m^3 to government activities. In addition, there was another 6500 m^3 of LLW sent to commercial burial grounds from government agencies or other licensed activities (e.g., fabrication of fuel for foreign reactors). The LLW from LWRs accounted for nearly 80 vol % of the commercial fuel cycle LLW and about 50 vol % of the total LLW. Institutional and industrial LLW accounted for about 40 vol % of the total LLW sent to commercial burial grounds and about 20 vol % of the total LLW. Government LLW accounted for almost 50 vol % of the total LLW. If no more land is licensed for commercial burial, Barnwell with its limited waste acceptance will be the only site still operating in the year 2000. Of the DOE sites, only NTS and Hanford will have ample land. All the other principal DOE sites except LASL will be exhausted and this site will have about 7 ha of usable land left.

30025 **(DOE/ET/41900—9) Ceramic phases for immobilization of ^{129}I.** Vance, E.R.; Agrawal, D.K.; Scheetz, B.E.; Pepin, J.G.; Atkinson, S.D.; White, W.B. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group; Pennsylvania State Univ., University Park (USA). Materials Research Lab.). 31 Jul 1981. Contract AC09-79ET41900. 43p. (ESG-DOE—13354). NTIS, PC A03/MF A01. Order Number DE81026067.

Materials for ultimate disposal of ^{129}I have been studied. At present, iodide-sodalite, though not ideal, appears to be the best material for ^{129}I immobilization from the aspects of ease of preparation, thermal stability, cost of materials, and leach resistance. Good consolidation of the material was achieved by sintering in air at 1000 to 1200°C, but the iodine content was significantly below stoichiometric expectations. Hot aqueous media preferentially removed iodine, apparently by OH^- substitution in near-neutral solutions, and I reversible reaction Cl^- exchange occurred in brine. Alternation of the sodalite also took place. Soxhlet leach rates were about 5×10^{-4} g/cm²-day by total weight loss, but physical weathering contributed significantly to this value. Moderate doses of radiation had no observable deleterious structural effects. Iodoboracites seemingly cannot be prepared by ceramic or nonhydrothermal wet chemical techniques. Fe-iodoboracite has inferior thermal stability to iodide-sodalite and was completely altered to hematite after treatment at 200°C in deionized water. Silver zeolites retained some iodine in the form of crystalline α-AgI at temperatures up to 1300°C even though heating above ~ 700°C altered the aluminosilicate framework. However, some of the iodine appeared to be present as soluble iodine, even in heated materials. Treatment at 200°C in deionized water or 2M NaCl significantly decreased the crystallinity of the aluminosilicate framework and the α-AgI reflections in the x-ray patterns were enhanced. Mild γ irradiations (~ 50 MR) affected the x-ray diffraction patterns of some of the zeolites. Various lead oxyhalides had very poor thermal stability.

30026 **(LBL—11981) Monitor for detecting nuclear waste leakage in a subsurface repository.** Klainer, S.; Hirschfeld, T.; Bowman, H.; Milanovich, F.; Perry, D.; Johnson, D. (Lawrence Berkeley Lab., CA (USA)). 5 Nov 1980. Contract W-7405-ENG-48. 89p. NTIS, PC A05/MF A01. Order Number DE81026429.

The remote fiber fluorimetric portion of the program is slightly ahead of schedule and proceeding well technically. Proof of principle has been demonstrated over a 0.2 km path length using an organic tracer material. Performance and design calculations have been made for the fiber optic components of the system. Optimized fibers have been ordered and special jigs and optical couplings are presently being fabricated. Progress on the high-sensitivity analyzer using coprecipitation techniques has proceeded well ahead of schedule with technical results far above expectations. Preliminary measurements in the UO_2^{2+}/CaF_2 detection system has proved sensitivities well beyond the natural background limit. While further improvement of sensitivity (to 10^{-15} g) already is planned, emphasis will now be placed on locating and dealing with possible interferences and on determining how to improve and optimize quantitative accuracy. In addition, simplication of the sample preparation procedure and downscaling to use very small (< 1 ml) groundwater samples is planned. In the longer time frame, work on maximum chemical speciation and the possibility of isotopic speciation will be undertaken. Once the coprecipitation procedures, instrumentation, and spectroscopy have been fully refined for uranium, then the process will be repeated for plutonium and perhaps americium and thorium.

30027 **(NUREG/CR—1683) Characterization of existing surface conditions at Sheffield low-level waste disposal facility. Final report.** Heim, G.E.; Machalinski, M.V. (Harding-Lawson Associates, Oak Brook, IL (USA)). Aug 1980. Contract NRC-02-80-057. 179p. NTIS, PC A09/MF A01.

The report presents results of the investigation to characterize the existing surface conditions at the Sheffield Low-Level Waste Disposal Facility, Sheffield, Illinois. The investigation is based on visual observations made in the field and detailed topographic surveying. The following information is presented: (1) Analyses of individual trench caps describing surface conditions and the ability of trench caps to minimize erosion and water infiltration into trenches; (2) A detailed survey of erosion at the site and a detailed description of the vegetation; and (3) A topographic survey. Numerous photographs are provided to document observations. Possible remedial actions, conclusion and recommendations for improving surface conditions are presented.

30028 **(ONWI—198) PSU/WES interlaboratory comparative methodology study of an experimental cementitious repository seal material.** Roy, D.M.; Grutzeck, M.W.; Mather, K. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Pennsylvania State Univ., University Park (USA). Materials Research Lab.; Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.). Sep 1980. Contract AC06-76RL01830. 108p. NTIS, PC A06/MF A01. Order Number DE81028236.

A study is underway in two separate laboratories to investigate possible use of portland cement grout as repository sealing material for underground isolation of nuclear waste. The labs involved are the Materials Research Laboratory of the Pennsylvania State University (PSU) and the Structures Laboratory (SL) of the US Army Engineer Waterways Experiment Station. The same cementitious (grout) mixture was prepared in each laboratory in September 1980, and tests were started. Testing included characterization of cement and fly ash by chemical, physical, and petrographic procedures. Tests of hardened specimens included restrained expansion, compressive strength, modulus of elasticity, density, permeability, x-ray diffraction, and scanning electron microscopy. Each laboratory made many of the same tests and some that were not directly comparable. This document (Report 1) contains largely 3- and 7-day results and none beyond 28-day ages.

30029 **(ORNL—5760) Final report on cermet high-level waste forms.** Kobisk, E.H.; Quinby, T.C.; Aaron, W.S. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 69p. NTIS, PC A04/MF A01. Order Number DE81029102.

Cermets are being developed as an alternate method for the fixation of defense and commercial high level radioactive waste in a terminal disposal form. Following initial feasibility assessments of this waste form, consisting of ceramic particles dispersed in an iron-nickel base alloy, significantly improved processing methods were developed. The characterization of cermets has continued through property determinations on samples prepared by various methods from a variety of simulated and actual high-level wastes. This report describes the status of development of the cermet waste form as it has evolved since 1977. 6 tables, 18 figures.

30030 **(ORNL—5774) Consolidation and permeability of salt in brine.** Shor, A.J.; Baes, C.F. Jr.; Canonico, C.M. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 41p. NTIS, PC A03/MF A01. Order Number DE81029103.

The consolidation and loss of permeability of salt crystal aggregates, important in assessing the effects of water in salt repositories, has been studied as a function of several variables. The kinetic behavior was similar to that often observed in sintering and suggested the following expression for the time dependence of the void fraction: $\mathrm{phi}(t) = \mathrm{phi}(0) - (A/B)\ln(1 + Bt/z(0)^3)$, where A and B are rate constants and z(0) is initial average particle size. With brine present, A and phi(0) varied linearly with stress. The initial void fraction was also dependent to some extent on the particle size distribution. The rate of consolidation was most rapid in brine and least rapid in the presence of only air as the fluid. A brine containing 5 m $MgCl_2$ showed an intermediate rate, presumably because of the greatly reduced solubility of NaCl. A substantial wall effect was indicated by an observed increase in the void fraction of consolidated columns with distance from the top where the stress was applied and by a dependence of consolidation rate on the column height and radius. The distance through which the stress fell by a factor of phi was estimated to change inversely as the fourth power of the column diameter. With increasing temperature (to 85°C), consolidation proceeded somewhat more rapidly and the wall effect was reduced. The permeability of the columns dropped rapidly with consolidation, decreasing with about the sixth power of the void fraction. In general, extrapolation of the results to repository conditions confirms the self-sealing properties of bedded salt as a storage medium for radioactive waste.

30031 **(ORNL/SUB—7164/1) Experimental studies concerning the drying of voloxidizer off-gases.** Holland, W.D.; Shah, A.H.; Kaiser, A.F.; McGee, J.C. (Tennessee Technological Univ., Cookeville (USA). Dept. of Chemical Engineering). Jul 1981. Contract W-7405-ENG-26. 139p. NTIS, PC A07/MF A01. Order Number DE81028025.

The results of an experimental program conducted to aid in the design of a tritium retention system to remove tritiated water from voloxidizer off-gases are presented. The retention system is expected to be a fixed-bed adsorption unit using a commercially available desiccant, such as molecular sieves, to dry the off-gases. The presence of iodine in the off-gas stream somewhat complicates the drying process since some iodine will be retained in the drying bed along with the tritiated water. The present work represents a follow-up to a study in which a small-scale (2-in.-diam by 30-in.-long) packed column of Linde Molecular Sieves (LMS) type 3A was repeatedly loaded and regenerated using a non-radioactive simulated voloxidizer off-gas containing water and iodine vapor. Both water and iodine loadings were measured and the regeneration characteristics of the bed were observed. The following studies were carried out: (1) testing of other desiccants showed LMS type 3A to be superior because of its high water loading and low iodine retention; (2) development of a column-mounted moisture detector; (3) adsorption isotherms; (4) iodine analysis using a commercial oxidant monitor; (5) tests on cartridge-type beds - a series of tests were conducted using three small drying beds connected in series. One further finding of this study was the importance of the clay binder (used in pelletized molecular sieves) in obtaining satisfactory or acceptably low iodine retention.

30032 **(ORNL/TM—7782) Survey: utilization of zeolites for the removal of radioactivity from liquid waste streams.** Roddy, J.W. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 39p. NTIS, PC A03/MF A01. Order Number DE81028035.

A survey was made of the literature and of experience at selected nuclear installations to provide information on the stability of inorganic ion exchangers when used for the decontamination of both low-level and high-level radioactive liquids. Results of past campaigns at the Savannah River Plant, Oak Ridge National Laboratory, and Rockwell Hanford Operations were examined. In addition, the performance of zeolites used for controlling water quality in nuclear fuel storage basins was evaluated. The literature survey served as a guide for identifying relevant material from foreign sources and supplemented the information obtained by direct contact of domestic researchers. The study included a brief review of the physical and chemical properties of zeolites. A secondary objective of the study was to compile data on the corrosion resistance of containment materials for zeolites.

30033 **(PNL—3774) INFX guide: summary of US DOE plans and policies for international cooperation in the field of radioactive waste management.** Harmon, K.M.; Kelman, J.A. (comps.). (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1981. Contract AC06-76RL01830. 151p. NTIS, PC A08/MF A01. Order Number DE81028208.

The purpose of this document is to provide, in one source, an overview and summary of major international cooperative activities such as long-term personnel exchanges, planning of complementary R and D programs, and testing programs like the one at Stripa for use by DOE and DOE contractor personnel responsible for planning such programs. The contents are as follows: waste management-general, high-level waste immobilization; transuranic wastes; low-level radioactive waste; airborne wastes; waste isolation in geologic repositories; marine disposal; spent fuel storage; transportation; uranium mill tailings; decontamination and decommissioning; and appendices which are for bilaterial waste management agreements; INFX policies and procedures, DOE contractor personnel and international agencies.

30034 **(PNL—3844) Strontium and cesium radionuclide leak detection alternatives in a capsule storage pool.** Larson, D.E.; Crawford, T.W.; Joyce, S.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1981. Contract AC06-76RL01830. 93p. NTIS, PC A05/MF A01. Order Number DE81023611.

A study was performed to assess radionuclide leak-detection systems for use in locating a capsule leaking strontium-90 or cesium-137 into a water-filled pool. Each storage pool contains about 35,000 L of water and up to 715 capsules, each of which contains up to 150 kCi strontium-90 or 80 kCi cesium-137. Potential systems assessed included instrumental chemical analyses, radionuclide detection, visual examination, and other nondestructive nuclear-fuel examination techniques. Factors considered in the assessment include: cost, simplicity of maintenance and operation, technology availability, reliability, remote operation, sensitivity, and ability to locate an individual leaking capsule in its storage location. The study concluded that an adaption of the spent nuclear-fuel examination technique of wet sipping be considered for adaption. In the suggested approoch, samples would be taken continuously from pool water adjacent to the capsule(s) being examined for remote radiation detection. In-place capsule isolation and subsequent water sampling would confirm that a capsule was leaking radionuclides. Additional studies are needed before implementing this option. Two other techniques that show promise are ultrasonic testing and eddy-current testing.

30035 **(RFP—3103) Purification and decontamination of a caustic water by reverse osmosis.** Plock, C.E.; Travis, T.N. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 28 Jul 1981. Contract AC04-76DP3533. 5p. NTIS, PC A02/MF A01. Order Number DE81027720.

A reverse osmosis pilot plant was used to decontaminate a caustic water containing low concentrations of uranium, plutonium, and americium. The concentrations of the plutonium and americium were less than one picocurie per liter in the product water. The

concentrations of the uranium was reduced to 4.4 picocuries per liter in the product water, which is a reduction of greater than 99%. The reverse osmosis pilot plant was operated at a 98% water recovery, which produced 25,000 gallons per day of product water.

30036 **(RFP—3119) Paint selection for coating radioactive-waste drums.** Briggs, J.L. (Rockwell International Corp., Golden, CO (USA). Energy Systems Group). 1 Jul 1980. Contract AC04-76DP03533. 22p. (CONF-8106126—1). NTIS, PC A02/MF A01. Order Number DE81026259.

From ASTM Rockwell International corrosion conference; Nashville, TN, USA (23 Jun 1981).

It is concluded that although the white epoxy Paint Sample E is suitable for coating waste drums, the additional pretreated costs of grit blasting prior to paint application would preclude adoption of that paint system. The specified 10.0-mil coating thickness of that coating would also incur higher costs. The Vorac epoxy-phenolic base paint (buff or yellow) was the only other paint that exhibited suitable corrosion and impact resistance required for coating the waste drums. In addition, that paint does not require a grit-blasted substrate or other costly pretreatment prior to coating.

30037 **(RFP—3250) Nuclear waste incineration technology status.** Ziegler, D.L.; Lehmkuhl, G.D.; Meile, L.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Rockwell International Corp., Golden, CO (USA). Transuranic Waste Systems Office). 15 Jul 1981. Contract AC04-76DP03533. 123p. NTIS, PC A06/MF A01. Order Number DE81025751.

The incinerators developed and/or used for radioactive waste combustion are discussed and suggestions are made for uses of incineration in radioactive waste management programs and for incinerators best suited for specific applications. Information on the amounts and types of radioactive wastes are included to indicate the scope of combustible wastes being generated and in existence. An analysis of recently developed radwaste incinerators is given to help those interested in choosing incinerators for specific applications. Operating information on US and foreign incinerators is also included to provide additional background information. Development needs are identified for extending incinerator applications and for establishing commercial acceptance.

30038 **(RHO-BWI-SA—146) Numerical modeling of the Near Surface Test Facility No. 1 and No. 2 heater tests.** Hocking, G.; Williams, J.; Boonlualohr, P.; Mathews, I.; Mustoe, G. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations; Agapito (J.F.T.) and Associates, Grand Junction, CO (USA); Dames and Moore, Burlington, MA (USA)). 1981. Contract AC06-77RL01030. 8p. (CONF-810624—9). NTIS, PC A02/MF A01. Order Number DE81026575.

From 22. US symposium on rock mechanics; Cambridge, MA, USA (29 Jun 1981).

Thermomechanical predictive calculations have been undertaken for two full scale heater tests No. 1 and No. 2 at the Near Surface Test Facility (NSTF) at Hanford, Washington. Numerical predictions were made of the basaltic rock response involving temperatures, displacements, strains and stresses due to energizing the electrical heaters. The basalt rock mass was modeled as an isotropic thermal material but with temperature dependent thermal conductivity, specific heat and thermal expansion. The fractured nature of the basalt necessitated that it be modeled as a cross anisotropic medium with a bi-linear locking stress strain relationship. The cross-anisotropic idealization was selected after characterization studies indicated that a vertical columnar structure persisted throughout the test area and no major throughgoing discontinuities were present. The deformational properties were determined from fracture frequency and orientation, joint deformational data, Goodman Jack results and two rock mass classification schemes. Similar deformational moduli were determined from these techniques, except for the Goodman Jack results. The finite element technique was utilized for both the non-linear thermal and mechanical computations. An incremental stiffness method with residual force correction was employed to solve the non-linear problem by piecewise linearization. Two and three dimensional thermomechanical scoping calculations were made to assess the significance of various parameters and associated errors with geometrical idealizations. Both heater tests were modeled as two dimensional axisymmetric geometry with water assumed to be absent. Instrument response was predicted for all of the thermocouples, extensometers, USBM borehole deformation and IRAD gages for the entire duration of both tests.

30039 **(SAI—509991R) Design and cost estimate for the SRL integrated hot off gas facility using selective adsorption.** Pence, D.T.; Kirstein, B.E. (Science Applications, Inc., San Diego, CA (USA)). Jul 1981. Contract AC09-76SR00819. 75p. NTIS, PC A04/MF A01. Order Number DE81029111.

Based on the results of an engineering-scale demonstration program, a design and cost estimate were performed for a 25-m^3/h (15-ft^3/min) capacity pilot plant demonstration system using selective adsorption technology for installation at the Integrated Hot Off Gas Facility at the Savannah River Plant. The design includes provisions for the destruction of NO/sub x/ and the concentration and removal of radioisotopes of ruthenium, iodine-129, tritiated water vapor, carbon-14 contaminated carbon dioxide, and krypton-85. The nobel gases are separated by the use of selective adsorption on mordenite-type zeolites. The theory of noble gas adsorption on zeolites is essentially the same as that for the adsorption of noble gases on activated charcoals. Considerable detail is provided regarding the application of the theory to adsorbent bed designs and operation. The design is based on a comprehensive material balance and appropriate heat transfer calculations. Details are provided on techniques and procedures used for heating, cooling, and desorbing the adsorbent columns. Analyses are also given regarding component and arrangement selection and includes discussions on alternative arrangements. The estimated equipment costs for the described treatment system is about $1,400,000. The cost estimate includes a detailed equipment list of all the major component items in the design. Related technical issues and estimated system performance are also discussed.

30040 **(SAND—80-2375) Solution chemistry techniques in SYNROC preparation.** Dosch, R.G.; Lynch, A.W. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 32p. NTIS, PC A03/MF A01. Order Number DE81028994.

Investigations of titanate-based ceramic forms for radioactive waste immobilization are underway at Sandia National Laboratories (SNLA) and at Lawrence Livermore National Laboratory (LLNL). Although the waste forms differ as to overall product composition, the waste-containing phases in both ceramic products have similar crystalline structure types. These include metallic phases along with oxides with structure types of the mineral analogues perovskite, zirconolite, and hollandite. Significant differences also exist in the area of processing. More conventional ceramic processing methods are used at LLNL to produce SYNROC while solution chemistry techniques involving metal alkoxide chemistry and ion exchange have been developed at SNLA to prepare calcium titanate-based waste ceramics. The SNLA techniques were recently modified and applied to producing SYNROC (compositions C and D) as part of an interlaboratory information exchange between SNLA and LLNL. This report describes the methods used in preparing SYNROC including the solution interaction, and hot-pressing methods used to obtain fully dense SYNROC monoliths.

30041 **(SAND—81-0007/1) Subseabed Disposal Program Plan. Volume I. Overview.** (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01. Order Number DE81027966.

The primary objective of the Subseabed Disposal Program (SDP) is to assess the scientific, environmental, and engineering feasibility of disposing of processed and packaged high-level nuclear waste in geologic formations beneath the world's oceans. High-level waste (HLW) is considered the most difficult of radioactive wastes to dispose of in oceanic geologic formations because of its heat and radiation output. From a scientific standpoint, the understanding developed for the disposal of such HLW can be used for other nuclear wastes (e.g., transuranic - TRU - or low-level) and materials from decommissioned facilities, since any set of barriers competent to contain the heat and radiation outputs of high-level waste will also contain such outputs from low-level waste. If subseabed disposal is found to be feasible for HLW, then other factors such as cost will become more important in considering subseabed

emplacement for other nuclear wastes. A secondary objective of the SDP is to develop and maintain a capability to assess and cooperate with the seabed nuclear waste disposal programs of other nations. There are, of course, a number of nations with nuclear programs, and not all of these nations have convenient access to land-based repositories for nuclear waste. Many are attempting to develop legislative and scientific programs that will avoid potential hazards to man, threats to other ocean uses, and marine pollution, and they work together to such purpose in meetings of the international NEA/Seabed Working Group. The US SDP, as the first and most highly developed R and D program in the area, strongly influences the development of subseabed-disposal-related policy in such nations.

30042 **(SAND—81-0768) Effects of clay-seam behavior on WIPP repository design.** Stone, C.M.; Krieg, R.D.; Branstetter, L.J. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 41p. NTIS, PC A03/MF A01. Order Number DE81028190.

The geology at the southeastern New Mexico WIPP site consists of bedded layers of rock salt, anhydrite, polyhalite, mixtures of those materials, and thin clay seams. In spite of their very small (0.005 m to 0.05 m) thickness, clay seams are important to structural characterization of the WIPP stratigraphy since slip might possibly take place across them. Results of a study to determine the effects of clay seam frictional slip on the closure of a well-defined drift configuration are described. A Mohr-Coulomb dry friction model was used to model the active clay seams. The main thrust of the study was to determine the effects of friction coefficient variability on drift closure. Results show that the drift closure varies by a factor of 3.0 over the range of friction coefficients studied. The maximum slip observed along any clay seam was 0.12 m. For values of $\mu > .7$, virtually no slip occurs along any clay seam.

30043 **(SAND—81-1323) Investigation of resonant signals recorded at well J-11, Nevada Test Site.** Long, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01. Order Number DE81025464.

After the Farm event, gages measuring horizontal accelerations at the bottom of Well J-11 began resonating at about 3 to 5 hertz on each shot. This investigation of possible causes concludes that the material surrounding the well casing has fallen away, allowing the casing to move freely in horizontal directions and causing the undesirable resonance.

30044 **(SAND—81-7061) Acoustic and thermal-sensor systems for the In-Situ Heat-Transfer Experiment.** Olson, L.O. (Sandia National Labs., Albuquerque, NM (USA); Washington Univ., Seattle (USA). Applied Physics Lab.). Jul 1981. Contract AC04-76DP00789. 143p. NTIS, PC A07/MF A01. Order Number DE81028187.

The In-Situ Heat Transfer Experiment (ISHTE) in the clay sediments of the deep ocean is part of a program to evaluate the feasibility of storing high-level nuclear waste in the subseabed sediments of the deep ocean. The equipment items developed in support of the ISHTE planned for the deep ocean north of Hawaii include an acoustic tracking and telemetry system, 15 thermal sensor probes for implanting into the sediments, in-situ data recording equipment, calibration of the probes, and a line source probe. (DLC)

30045 **(PNL-TR—415) Process for the denitrification of high-level radioactive liquid wastes.** Gattys, F.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 10 Jul 1981. Translation of . German(FRG) Patent 2,807,324. 17p. NTIS, PC A02/MF A01. Order Number DE81026875.

A process is claimed for denitrification of high-level concentrated radioactive liquid wastes by using powdered paraformaldehyde. Commercial paraformaldehyde with a low water content and mean particle size smaller than 60 microns is introduced as denitrifying agent at about 110°C into the liquid waste. A buffer of citric acid and phosphate is added during the denitrification reaction. The escaping gases contain nitrogen oxides which are recombined and concentrated to about 40% by weight nitric acid.

30046 **Study of regional temperature and thermohydrologic effects of an underground repository for nuclear wastes in hard rock.** Wang, J.S.Y.; Tsang, C.F.; Cook, N.G.W.; Witherspoon, P.A. (Earth Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Geophysical Research ;* **86**: No. B5, 3759-3770(10 May 1981).

Heat released by the radioactive decay of nuclear wastes in an underground repository causes a long-term thermal disturbance in the rock mass. The nature of this disturbance for a planar repository 3000 m in diameter at a depth of 500 m below surface is investigated. Loaded initially with a power density of 10 W/m^2 of spent fuel assemblies 10 years after discharge from a reactor, the maximum increase in temperature of the repository in granite is about 50 °C and the epicentral thermal gradient about 70 °C/km. Different waste forms and periods before buriel have significant effects on the thermal disturbance. The effects of temperature changes in the groundwater flow are evaluated with simple models of a vertical fracture connected to a horizontal fracture in the rock mass. The buoyancy groundwater flow through the vertical fracture is a function of both the vertical and the horizontal fracture transmissivities, as well as the changes in density and viscosity of groundwater caused by the temperature changes. Finite hydraulic recharge from the surrounding rock mass affects the thermohydrologic disturbance.

30047 **Electric controlled air incinerator for radioactive wastes.** Hootman, H.E.; Warren, J.H. (to Department of Energy). US Patent 4,259,910. 7 Apr 1981. Filed date 18 Jul 1979. vp.

PAT-APPL-058420.

A two-stage incinerator is provided which includes a primary combustion chamber and an afterburner chamber for offgases. The latter is formed by a plurality of vertical tubes in combination with associated manifolds which connect the tubes together to form a continuous tortuous path. Electrically-controlled heaters surround the tubes while electrically-controlled plate heaters heat the manifolds. A gravity-type ash removal system is located at the bottom of the first afterburner tube while an air mixer is disposed in that same tube just above the outlet from the primary chamber. A ram injector in combination with rotary magazine feeds waste to a horizontal tube forming the primary combustion chamber.

30048 **Process for decontaminating radioactive liquids using a calcium cyanamide-containing composition.** Silver, G.L. (to Dept. of Energy). US Patent Application 190,304. 24 Sep 1980. 21p.

The present invention provides a process for decontaminating a radioactive liquid containing a radioactive element capable of forming a hydroxide. This process includes the steps of contacting the radioactive liquid with a decontaminating composition and separating the resulting radioactive sludge from the resulting liquid. The decontaminating composition contains calcium cyanamide.

30049 **Decontamination of alkaline radioactive waste by ion exchange.** Wiley, J.R. (Savannah River Lab., Aiken, SC). Contract AT(07-2)-1. *Industrial and Engineering Chemistry Process Design and Development ;* **17**: No. 1, 67-71(Jan 1978).

An ion-exchange process was developed to remove cesium-137, strontium-90, and plutonium from alkaline salt solutions. About 20 million gal of alkaline salt cake and supernatant solution from processing nuclear fuels and materials for defense programs are presently stored at the Savannah River Plant. Ion exchange may be used to decontaminate this radioactive waste during a proposed waste solidification program. In development tests 100-L quantities of liquid waste were decontaminated. Decontamination factors were 4×10^5 for ^{137}Cs, 5×10^3 for ^{90}Sr, and 300 for Pu. The separated radionuclides were concentrated by a factor of 1500 and immobilized by adsorption onto zeolite. Residual ^{137}Cs, ^{90}Sr, and Pu activity in the decontaminated product was about 6 nCi/g. ^{106}Ru, the most hazardous radionuclide remaining after ^{137}Cs removal, will decay to 6 nCi/g about 10 years after the waste is processed.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 30026, 30027, 31276

30050 (ORNL-tr—4771) Estimate of the consequences of the accident water penetration into an in-situ cavern during the operating phase. Keinzler, B. (Oak Ridge National Lab., TN (USA)). [nd]. Translation source information not available . 19p. NTIS, PC A02/MF A01. Order Number DE81029147.

On the assumption that an in-situ cavern with an effective volume of 75,000 m^3 has been filled to capacity, an attempt is made to estimate the effects of a water penetration accident on the contamination of the groundwater. The release of the nuclides tritium, ^{90}Sr, ^{137}Cs and the alpha-emitters ^{238}Pu and ^{239}Pu is examined for this purpose. The product characteristics are assumed to be such that leaching is the decisive factor for release within a period of 50 years following the influx of the water. Thereafter there are total corrosion and decay of the waste product in direct contact with the brine, so that the entire activity of the upper strata reaches the cavern brine, with the exception of a residual amount. The leaching continues from deeper strata. If we assume that the leached activity is homogeneously distributed over the cavern volume and then consider the release of the contaminated brine due to convergence of the cavern with a stratum containing groundwater, the expansion of the radionuclides can be calculated over this area. It has been demonstrated that the filling state of the cavern has no influence on the RN [radionuclide] concentration at a given distance from the cavern, if we assume that contaminated brine reaches the groundwater due to convergence of the cavern and the release rate over time is proportional to the free volume of the cavern. Assuming that the convergence of the cavern at a maximum distance of 500 m decreases over time, the concentrations of the RNs in question in the groundwater will always remain below the derived maximum permissible concentration (MPC) values.

30051 (PB—81-114910) Implementation of long-term environmental radiation standards: the issue of verification. (National Research Council, Washington, DC (USA)). 1979. Contract EPA-68-01-3931. 76p. NTIS PC MF A01.

In response to a request from the U.S. Environmental Protection Agency (EPA), the National Research Council, through a Panel of the Committee on Radioactive Waste Management, studied the problems of verifying the satisfactory implementation of (i.e., compliance with) environmental radiation standards for deep geologic repositories for high-level radioactive wastes. This report contains the major conclusions and recommendations of the study. The report begins with a summary of the Panel's major conclusions and recommendations. Important background information on radioactive wastes--their origin, the amounts presently in existence, and possible permanent disposal of the wastes in deep geologic formations--is discussed in Chapter 1. The potential risks posed by these wastes is described in Chapter 2. The long-term environmental radiation standards that EPA is required to establish, and the feasibility and means of assuring compliance with such standards are examined in Chapter 3. The information that is required for purposes of assuring long-term compliance is described in Chapter 4, and the status and limitations of current knowledge are examined in Chapter 5.

30052 (PNL—3574) Geochemical modeling: a review. Jenne, E.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 58p. NTIS, PC A04/MF A01. Order Number DE81028969.

Two general families of geochemical models presently exist. The ion speciation-solubility group of geochemical models contain submodels to first calculate a distribution of aqueous species and to secondly test the hypothesis that the water is near equilibrium with particular solid phases. These models may or may not calculate the adsorption of dissolved constituents and simulate the dissolution and precipitation (mass transfer) of solid phases. Another family of geochemical models, the reaction path models, simulates the stepwise precipitation of solid phases as a result of reacting specified amounts of water and rock. Reaction path models first perform an aqueous speciation of the dissolved constituents of the water, test solubility hypotheses, then perform the reaction path modeling. Certain improvements in the present versions of these models would enhance their value and usefulness to applications in nuclear-waste isolation, etc. Mass-transfer calculations of limited extent are certainly within the capabilities of state-of-the-art models. However, the reaction path models require an expansion of their thermodynamic data bases and systematic validation before they are generally accepted.

0540 Health And Safety

REFER ALSO TO CITATION(S) 30034, 30680, 31203, 31276

30053 (NUREG/CR—1736) Comparison of physical chemical properties of powders and respirable aerosols of industrial mixed uranium and plutonium oxide fuels. Technical report. Eidson, A.F. (Inhalation Toxicology Research Inst., Albuquerque, NM (USA)). Nov 1980. 25p. NTIS, PC A02/MF A01.

The purpose of these studies is to delineate physical and chemical factors important in determining the biological fate of mixed-oxides if inhaled. The similarity between powders and respirable aerosols was also studied. Four representative mixed-oxide powders were obtained from fuel fabrication enclosures. Aerosols of the powders were regenerated in the laboratory and collected for analysis. Crystal structure analysis of powders and aerosols showed that material from processes prior to pellet sintering consisted of discrete PuO2 and UO2 phases while materials from the pellet grinding step were in a (U,Pu)O1.96 solid solution. Incorporation of Pu into a solid solution with UO2 caused an increase in the Pu dissolution rate in vitro. Infrared spectral analysis showed that surfaces of aerosol particles contained adsorbed CO2 and H2O, suggesting that the reduction caused by sintering was partially reversed at the surface. X-ray diffraction results indicated that analysis of powders is sufficient to characterize the aerosol form. Alpha spectroscopy results indicated that isotopic composition of aerosols from steps following powder comminution could be obtained from powder analysis. An adequate estimate might be made for materials from steps prior to powder comminution, but aerosol analysis is preferred.

30054 (ORNL/TM—7923) Methods and procedures for internal radiation dosimetry at ORNL. Gupton, E.D. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 77p. NTIS, PC A04/MF A01. Order Number DE81028075.

Procedures, methods, materials, records, and reports used for accomplishing the personnel, internal radiation monitoring program at Oak Ridge National Laboratory are described for the purpose of documenting what is done now for future reference. This document does not include procedures for nuclear accident dosimetry except insofar as routine techniques may apply also to nuclear accident dosimetry capability.

30055 (PNL-SA—9496) Peace-time radiological training for fire fighting and paramedic staff. (Battelle Pacific Northwest Labs., Richland, WA (USA)). [nd]. Contract AC06-76RL01830. 43p. NTIS, PC A03/MF A01. Order Number DE81028109.

The shipment of radioactive materials over commercial highways has had a proven record of safety for many years. Accidents involving radioactive material have been rare. However, good emergency planning requires that fire protection agencies be prepared for such an incident. In an effort to provide this preparedness, the Benton County Department of Emergency Services, with the cooperation of the Washington Public Power Supply System and US Department of Energy, Richland Office, has prepared this manual for local fire fighting and paramedic staff. This manual provides a basic understanding of radioactivity and the role of these teams during an emergency involving radioactive material.

0550 Regulations

REFER ALSO TO CITATION(S) 31025, 31139

30056 (AGNS—35900-CONF-129) Inspections: a cost-effective approach. Joseph. C. (Allied-General Nuclear Services, Barnwell, SC (USA)). Jun 1981. Contract AC09-78ET35900. 18p. (CONF-810706—30). NTIS, PC A02/MF A01. Order Number DE81029074.

From Institute of Nuclear Materials Management conference; San Francisco, CA, USA (13 Jul 1981).

A Computerized Nuclear Materials Control and Accounting System such as is installed and operating at the Barnwell Nuclear Fuel Plant provides the capability to conduct inspection functions via telephone from remote locations. Direct access to measurement instrumentation readings is featured. An up-to-the-minute status report provides a photograph of the status of measurement routines at all key measurement points. These two features provide an inspector with the flexibility to randomly obtain timely and independent verifications. Accounting reports and material balance reports are available from the files or near real-time reports can be produced on demand. Significant cost reductions for auditing and inspections can be realized while moe timely and responsive inspections are achieved.

30057 (DOE/DP—0001-8) Semi-annual report on strategic special nuclear material inventory differences. (Department of Energy, Washington, DC (USA). Office of Safeguards and Security). Aug 1981. 24p. NTIS, PC A02/MF A01. Order Number DE81027703.

This eighth periodic semiannual report of inventory differences covers the second six months of fiscal year 1980 (April 1, 1980, through September 30, 1980), for the Department of Energy (DOE) and DOE contractor facilities possessing significant quantities of strategic special nuclear material. Strategic special nuclear material is plutonium or uranium-233 or uranium-235 in material whose uranium-235 content is 20 percent or greater (known as highly enriched uranium). A significant quantity is either 2 kilograms of plutonium or uranium-233 or 5 kilograms of uranium-235 in highly enriched uranium or the appropriate weighted combination. All Inventory Differences reported here have been analyzed, investigated when necessary, and resolved. These data and explanations, together with the absences of physical indications of any theft attempt, support a finding that during this period no theft or diversion of strategic special nuclear material has occurred.

30058 (HEDL-SA—2432) Laboratory quality assurance and its role in the safeguards analytical laboratory evaluation (SALE) program. Delvin, W.L.; Pietri, C.E. (Hanford Engineering Development Lab., Richland, WA (USA); Department of Energy, Argonne, IL (USA). New Brunswick Lab.). Jul 1981. Contract AC14-76FF02170. 9p. (CONF-810738—1). NTIS, PC A02/MF A01. Order Number DE81027890.

From 4. SALE program participants meeting; Argonne, IL, USA (Jul 1981).

Since the late 1960's, strong emphasis has been given to quality assurance in the nuclear industry, particularly to that part involved in nuclear reactors. This emphasis has had impact on the analytical chemistry laboratory because of the importance of analytical measurements in the certification and acceptance of materials used in the fabrication and construction of reactor components. Laboratory quality assurance, in which the principles of quality assurance are applied to laboratory operations, has a significant role to play in processing, fabrication, and construction programs of the nuclear industry. That role impacts not only process control and material certification, but also safeguards and nuclear materials accountability. The implementation of laboratory quality assurance is done through a program plan that specifies how the principles of quality assurance are to be applied. Laboratory quality assurance identifies weaknesses and deficiencies in laboratory operations and provides confidence in the reliability of laboratory results. Such confidence in laboratory measurements is essential to the proper evaluation of laboratories participating in the Safeguards Analytical Laboratory Evaluation (SALE) Program.

30059 (LA—8509-MS) Analytical techniques to reduce the number of physical standards needed for neutron coincidence counters. Bosler, G.E. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 23p. (ISPO—117). NTIS, PC A02/MF A01. Order Number DE81028663.

A technique for performing calculationally assisted evaluations of shift-register coincidence counter data is discussed. An example of a typical application for some high mass PuO_2 samples is presented. Methods for applying the technique to general coincidence counter use are described.

30060 (LA-UR—81-2159) Development and demonstration of near-real-time accounting systems for reprocessing plants. Cobb, D.D.; Hakkila, E.A.; Dayem, H.A.; Shipley, J.P.; Baker, A.L. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 12p. (CONF-810706—29). NTIS, PC A02/MF A01. Order Number DE81028775.

From Institute of Nuclear Materials Management conference; San Francisco, CA, USA (13 Jul 1981).

A program to develop and demonstrate near-real-time accounting systems for reprocessing plants has been active at Los Alamos since 1976. The technology has been developed through modeling and simulation of process operation and measurement systems and evaluation of these data using decision analysis techniques. Aspects of near-real-time systems have been demonstrated successfully at the AGNS reprocessng plant as part of a joint study of near-real-time accounting.

30061 (PB—81-122855) Details of criminological investigations of large-valued thefts related to nuclear materials (diversion safeguards program). Leachman, R.B.; Cornella, A.P. (Kansas State Univ., Manhattan (USA)). Jun 1972. 69p. NTIS, PC A04/MF A01.

Studies were made of five areas of criminology which have great similarity to the case of nuclear materials. Actual cases of crimes were analyzed by experts in law enforcement and criminal justice. To identify fields of analogous criminology, possible characteristics of nuclear material thefts were considered: total value, high unit cost, limited marketability, special technology for handling, and licensing. The items considered to be analogous to nuclear materials in these aspects were: narcotics, data (as exists in computer memories, tapes, or discs), precious metal and gems, objects of art, and weapons. A criminology survey was conducted in which 509 individuals received one or more questionnaires soliciting opinion responses. Sixty-five questionnaires were returned. Eighty-four individuals replied by letter indicating inadequate knowledge of the crimes being surveyed. The questionnaire was supplemented by 18 interviews with criminal justice and industry personnel for more definitive information on diversion problems. Results of this survey are reported.

30062 (SAND—81-1242) Target assessment performance with 5″ and 9″ television monitors. Weston, L.M.; Finley, B.H.; Prairie, R.R. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1981. Contract AC04-76DP00789. 55p. NTIS, PC A04/MF A01. Order Number DE81026754.

The major purpose of this study was to contrast target assessment performance with 5″ and 9″ television monitors. The scenarios consisted of intrusion, nuisance, and false alarm scenarios under daytime and nighttime illumination levels. Analyses revealed no significant performance differences between the 5″ and 9″ monitors.

30063 Dynamic materials control development and demonstration program. Augustson, R.H. (Los Alamos Scientific Lab., NM). *Nuclear Materials Management ;* 7: 305-318(1978).

The current status of the DOE Dynamic Materials Control program, DYMAC, being developed at the Los Alamos Scientific Laboratory, is reviewed and the next phase of the program is discussed.

06 FUSION FUELS

0602 Processing

30064 (CONF-810804—10) Recovery of tritium from a liquid lithium blanket. Talbot, J.B. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE81025466.

From National heat transer conference; Milwaukee, WI, USA (2 Aug 1981).

The sorption of tritium on yttrium from liquid lithium and the subsequent release of tritium from yttrium by thermal regeneration of the metal sorbent were investigated to study such a tritium-recovery process for a fusion reactor blanket of liquid lithium. Recent static sorption experiments have shown the effects of lithium temperature and possible impurities on the sorption of tritium. Diffusivity data, obtained from previous tritium recovery experiments, were evaluated to show the importance of the yttrium surface condition in controlling the release of tritium.

30065 (UCID—19096) Fill tube fitted spheres. Ives, B.H. (Lawrence Livermore National Lab., CA (USA)). 13 Jul 1981. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01. Order Number DE81028492.

The high temperature diffusion technique for fuel filling of some future direct drive cryogenic ICF targets may be unacceptable. The following describes a technique of fitting a 1 mm diameter x 6 μm thick glass microsphere with an ~ 50 μm O.D. glass fill tube. The process of laser drilling a 50 μm diameter hole in the microsphere wall, technique for making the epoxy joint between the sphere and fill tube, as well as the assembly procedure are also discussed.

30066 (UCRL—15357) Investigation on non-glass laser fusion targets: their fabrication, characterization, and transport. Charged Particle Research Laboratory report No. 2-81, progress report, June 1, 1980-January 31, 1981. Kim, K. (Illinois Univ., Urbana (USA). Dept. of Electrical Engineering). 1981. Contract W-7405-ENG-48. 86p. NTIS, PC A05/MF A01. Order Number DE81026566.

A summary is presented of the research progress made under LLNL Subcontract 8320003 for the period of June 1, 1980 through January 31, 1981. The main theme of the research has continued to be the development of techniques for fabricating, characterizing, and transporting laser fusion targets on a continuous basis. The target fabrication techniques are intended mainly for non-glass spherical shell targets, both cryogenic and non-cryogenic. Specifically, progress has been made in each of the following categories. (1) Investigation of liquid hydrogen behavior inside a spherical laser fusion target. (2) Development of automated target characterization scheme. (3) Study of cryogenic target fabrication scheme utilizing cold-gas-levitation and electric field positioning. (4) Development of a cryogenic target fabrication system based on target free-fall method. (5) Generation of hydrogen powder using electrohydrodynamic spraying. (6) Study of target-charging techniques for application to contactless cryogenic target fabrication. (7) Development of hollow metal sphere production technique. A brief summary of the research progress made in each category is presented.

30067 Method for introduction of gases into microspheres. Hendricks, C.D.; Koo, J.C.; Rosencwaig, A. (to Department of Energy). US Patent 4,257,798. 24 Mar 1981. Filed date 26 Jul 1979. vp.

PAT-APPL-061166.

A method for producing small hollow glass spheres filled with a gas by introduction of the gas during formation of the hollow glass spheres. Hollow glass microspheres having a diameter up to about 500 mu with both thin walls (0.5 to 4 mu) and thick walls (5 to 20 mu) that contain various fill gases, such as ar, kr, xe , br, dt, h2, d2, he, n2, ne, co2, etc. In the interior thereof, can be produced by the diffusion of the fill gas or gases into the microsphere during the formation thereof from a liquid droplet of glass-forming solution. This is accomplished by filling at least a portion of the multiple-zone drop-furnace used in producing hollow microspheres with the gas or gases of interest, and then taking advantage of the high rate of gaseous diffusion of the fill gas through the wall of the gel membrane before it transforms into a glass microsphere as it is processed in the multiple-zone furnace. Almost any gas can be introduced into the inner cavity of a glass microsphere by this method during the formation of the microsphere provided that the gas is diffused into the gel membrane or microsphere prior to its transformation into glass. The process of this invention provides a significant savings of time and related expense of filling glass microspheres with various gases. For example, the time for filling a glass microballoon with 1 atmosphere of dt is reduced from about two hours to a few seconds.

30068 Method for producing small hollow spheres. Dressler, J.L.; Koo, J.C.; Rosencwaig, A. (to Department of Energy). US Patent 4,257,799. 24 Mar 1981. Filed date 26 Jul 1979. vp.

PAT-APPL-061167.

A method for producing small hollow spheres of glass having an outer diameter ranging from about 100 mu to about 500 mu with a substantially uniform wall thickness in the range of about 5-20 mu . The method involves introducing aqueous droplets of glass-forming solution into a long vertical drop oven or furnace having varying temperature regions. In one embodiment, one of the temperature regions is lower than both the preceeding region and the subsequent region. One region utilizes a temperature of at least 200* C. Higher than the melting point of the glass-forming material in the solution and, for example, may be at least 3 times higher than the temperature of the preceeding region. In addition, there is a sharp temperature gradient between these regions. As each droplet of solution passes through a first region it forms into a gel membrane having a spherical shape and encapsulates the rest of the drop retained in the elastic outer surface and the water entrapped within diffuses rapidly through the thin gel membrane which causes more of the glass-forming material to go out of solution and is incorporated into the gel membrane causing it to grow in size and become hollow. Thus produced hollow glass sphere has a sphericity, concentricity, and wall uniformity of better than 5%. The sphere is capable of retaining material of up to at least 100 atmospheres therein over long periods of time. In one embodiment.

30069 Cryogenic target formation using cold gas jets. Hendricks, C.D. (to Department of Energy). US Patent 4,258,075. 24 Mar 1981. Filed date 11 Oct 1979. vp.

PAT-APPL-084023.

A method and apparatus using cold gas jets for producing a substantially uniform layer of cryogenic materials on the inner surface of hollow spherical members having one or more layers, such as inertially imploded targets. By vaporizing and quickly refreezing cryogenic materials contained within a hollow spherical member, a uniform layer of the materials is formed on an inner surface of the spherical member. Basically the method involves directing cold gas jets onto a spherical member having one or more layers or shells and containing the cryogenic material, such as a deuterium-tritium (Dt) mixture, to freeze the contained material, momentarily heating the spherical member so as to vaporize the contained material, and quickly refreezing the thus vaporized material forming a uniform layer of cryogenic material on an inner surface of the spherical member.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 30018

30070 Low temperature ion source for calutrons. Bell, W. A.; Howell, G. D.; Veach, A. M. (to to Department of Energy). US Patent 4,253,026. 24 Feb 1981. Filed date 10 Oct 1979. vp.

A new ion source assembly for calutrons has been provided for the efficient separation of elements having high vapor pressures. The strategic location of cooling pads and improved insulation permits operation of the source at lower temperatures. A vapor valve constructed of graphite and located in a constantly increasing tem-

perature gradient provides reliable control of the vapor flow from the charge bottle to the arc chamber. A pronounced saving in calutron operating time and equipment maintenance has been achieved with the use of the present ion source.

30071 **Deuterium enrichment by selective photoinduced dissociation of a multihalogenated organic compound.** Herman, I.P.; Marling, J.B. (to Department of Energy). US Patent 4,257,860. 24 Mar 1981. Filed date 19 Sep 1978. vp. PAT-APPL-943833.

A method for deuterium enrichment by photoinduced dissociation which uses as the deuterium source a multihalogenated organic compound selected from the group consisting of a dihalomethane, a trihalomethane, a 1,2-dihaloethene, a trihaloethene, a tetrahaloethane and a pentahaloethane. The multihalogenated organic compound is subjected to intense infrared radiation at a preselected wavelength to selectively excite and thereby induce dissociation of substantially only those molecules containing deuterium to provide a deuterium enriched dissociation product. The deuterium enriched product may be combusted with oxygen to provide deuterium enriched water. The deuterium depleted undissociated molecules may be redeuterated by treatment with a deuterium source such as water.

0702 Radiation Sources

30072 **(AD-A—090945) Photoelastic stress and fracture analysis of two neutron tube designs. Final report.** Parks, V.J.; Sanford, R.J. (Naval Research Lab., Washington, DC (USA)). 15 Oct 1980. 26p. NTIS, PC A03/MF A01.

Photoelastic stress analysis and fracture stress analysis were carried out on two-dimensional models of the cross-sections of the M5N and M19N designs of a neutron tube under axial load. Of special interest was the metal-ceramic interface, where failure had been experienced. Both types of analysis showed the M5N to be superior to the M19N for the given loading in the area of failure. Tangential stresses along the free surfaces, and mixed-mode stress intensity factors for various crack lengths along the interface are reported.

30073 **Proposal of a novel high intense neutron source for radiation therapy.** Drosg, M. (Vienna Univ. (Austria). Inst. fuer Experimentalphysik; Los Alamos Scientific Lab., NM (USA)). *Zeitschrift fuer Physik [Sektion] A: Atoms and Nuclei* ; **298**: No. 4, 297-299(Dec 1980).

When using the $^{1}H(t,n)^{3}He$ reaction instead of the $^{3}H(d,n)^{4}He$ reaction for a high intense neutron source, the power dissipated in the target which limits the maximum obtainable intensity is a factor of 70 less. Therefore higher fluxes than with d-T sources can be obtained with nearly no low energy background which is important for radiation therapy. The relevant properties of this source are discussed and its practicability is investigated.

30074 **(DOE/NE—0014) Executive strategy plan for beneficial uses program: cesium-137 sewage sludge irradiation.** (Department of Energy, Washington, DC (USA)). Jul 1981. 34p. NTIS, PC A03/MF A01. Order Number DE81026475.

Energy-efficient disinfection of sewage sludge, permitting its use as a fertilizer and soil conditioner in areas open to public access or on certain food chain crops, is possible using the process technology developed by Sandia National Laboratories under DOE and EPA joint support. This process accomplishes disinfection by gamma ray irradiation with cesium-137, a by-product isotope recovered from reprocessing of defense production waste. Disinfection with cesium-137 gamma irradiation provides an energy-efficient option for the Nation's cities to beneficially utilize sewage sludge, while at the same time conserving energy by utilizing a radioisotope, traditionally considered waste, in a beneficial manner. While the Sandia sludge irradiation technology has successfully completed its research and development phase, a major consideration remains: the introduction of a new technology into a marketplace which traditionally is skeptical of new products or process technologies until their performance is well proven. This document analyzes the factors important to market introduction of this new technology, develops options, and recommends a program strategy for transfer of the Sandia sludge irradiation technology to the marketplace by developing public awareness and acceptance, and by stimulating private sector commercialization interest.

30075 **(SAND—81-1665) Upgrading the intense neutron source high voltage power supply.** Riedel, A.A. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 12p. NTIS, PC A02/MF A01. Order Number DE81028970.

The intense neutron source high voltage power supply displayed breakdown problems from the start of the project. This report analyzes the problems and provides solutions for upgrading the supply. Recent modifications have virtually eliminated power supply internal breakdowns. The report also specifies preacceptance tests for a supply to assure reliable operation under an arcing load.

30076 **(UCID—19161) Pneumatic sample-transfer system for use with the Lawrence Livermore National Laboratory rotating target neutron source (RTNS-I).** Williams, R.E. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 42p. NTIS, PC A03/MF A01. Order Number DE81028244.

A pneumatic sample-transfer system is needed to be able to rapidly retrieve samples irradiated with 14-MeV neutrons at the Rotating Target Neutron Source (RTNS-I). The rabbit system, already in place for many years, has been refurbished with modern system components controlled by an LSI-11 minicomputer. Samples can now be counted three seconds after an irradiation. There are many uses for this expanded 14-MeV neutron activation capability. Several fission products difficult to isolate from mixed fission fragments can be produced instead through (n,p) or (n,α) reactions with stable isotopes. Mass-separated samples of Nd, Mo, and Se, for example, can be irradiated to produce Pr, Nb, and As radionuclides sufficient for decay scheme studies. The system may also be used for multielement fast-neutron activation analysis because the neutron flux is greater than 2×10^{11} n/cm^2-sec. Single element analyses of Si and O are also possible. Finally, measurements of fast-neutron cross sections producing short-lived activation products can be performed with this system. A description of the rabbit system and instructions for its use are presented in this report.

0703 Isotopic Power Supplies

REFER ALSO TO CITATION(S) 30778, 30779

30077 **(DOE/SF/01123—T32) BIP-S program plan.** McCormick, J.E. (AiResearch Mfg. Co., Phoenix, AZ (USA)). 13 Jul 1977. Contract AC03-76SF01123. 24p. NTIS, PC A02/MF A01.

A description of the technical program plan and the associated budget on a go-forward basis for Phase I of the Brayton Isotope Power Supply are discussed. The plan represents a departure from the program pursued to date in that the Columbian components will be replaced with Hastelloy-X components. (WHK)

30078 **(DOE/SF/01123—T42) Isotope Brayton ground-demonstration testing and flight qualification: executive summary.** (AiResearch Mfg. Co., Phoenix, AZ (USA)). 9 Dec 1974. Contract AC03-76SF01123. 30p. NTIS, PC A03/MF A01. Order Number DE81026753.

The organization and management of a program for designing, ground testing and flight qualification of a radioisotope-fueled Brayton cycle power system for space vehicles are summarized. The conceptual design, and predicted performance and cost of the Brayton power system and the ground demonstration are outlined. The personnel and facilities which will be used in the program are described. (LCL)

30079 **(DOE/SF/01123—T44) Preliminary hazard analysis for the Brayton isotope Ground Demonstration System (including vacuum test chamber).** Miller, L.G. (AiResearch Mfg. Co., Phoenix, AZ (USA)). 30 Nov 1975. Contract AC03-76SF01123. 20p. NTIS, PC A02/MF A01. Order Number DE81025729.

This preliminary hazards analysis of the Brayton Isotope Power System (BIPS) Ground Demonstration Systems (GDS) pre-

sents tabulated information on possible hazards or undesirable events during the preparation and operation of the BIPS-GDS and of the test facilities, category of each hazard from negligible to catastrophic, cause and effect of hazard, and corrective actions. (LCL)

30080 **(DOE/SF/01123—T45) ERDA BIPS program action items.** (AiResearch Mfg. Co., Phoenix, AZ (USA)). 15 Jul 1977. Contract AC03-76SF01123. 19p. NTIS, PC A02/MF A01.

The current status of Brayton Isotope Power System (BIPS) program action items is presented with tabulated information identifying each item, its status disposition or explanatory remarks, responsible engineer, and expected completion date. (LCL)

30081 **(DOE/SF/01123—T47) Isotope Brayton ground demonstration testing and flight qualification. Volume 1. Technical program.** (AiResearch Mfg. Co., Phoenix, AZ (USA)). 9 Dec 1974. Contract AC03-76SF01123. 304p. NTIS, PC A14/MF A01. Order Number DE81026273.

A program is proposed for the ground demonstration, development, and flight qualification of a radioisotope nuclear heated dynamic power system for use on space missions beginning in the 1980's. This type of electrical power system is based upon and combines two aerospace technologies currently under intense development; namely, the MHW isotope heat source and the closed Brayton cycle gas turbine. This power system represents the next generation of reliable, efficient economic electrical power equipment for space, and will be capable of providing 0.5 to 2.0 kW of electric power to a wide variety of spacecraft for earth orbital and interplanetary missions. The immediate design will be based upon the requirements for the Air Force SURVSATCOM mission. The proposal is presented in three volumes plus an Executive Summary. This volume describes the tasks in the technical program.

30082 **(DOE/SF/01123—T49) ERDA BIPS workhorse loop test procedures.** (AiResearch Mfg. Co., Phoenix, AZ (USA)). 14 Feb 1977. Contract AC03-76SF01123. 97p. NTIS, PC A05/MF A01.

The procedures to be followed in testing of the Brayton Isotope Power System (BIPS) workhorse loop are described. The BIPS, is a space power system designed to supply 1.3 kW of electrical power for up to 7 years. The power conversion system includes a closed Brayton cycle gas turbine engine, isotope heat source, recuperator, and a space radiator. The ground demonstration system turbo-alternator-compressor, heat source assembly, recuperator and support structure are all flight-type hardware. An electrically heated isotope heat source support simulator and a gas-to-liquid heat rejection space radiator simulator complete the demonstrator loop. The workhorse ground demonstrator system will undergo performance testing in a simulated space environment. The workhorse loop differs little from the actual Ground Demonstration System (GDS); the GDS uses refractory alloy turbine plenum and ducts while these components are made of superalloy in the workhorse loop (WHL). In addition, the workhorse system uses superalloy electric heaters in place of the two electrically heated isotope heat source simulators (containing refractory alloy heat exchangers). The WHL facilities the earliest possible checkout of GDS components and test facility while also providing the capability of system operation at the three-heat-source design condition to confirm performance at higher power levels. Following WHL evaluation, the loop will be reassembled with the refractory components and heat source assemblies and GDS testing initiated.

30083 **(DOE/SF/01123—T50) Mini-BRU radial compressor redesign and test report.** Zanelli, E.A. (AiResearch Mfg. Co., Phoenix, AZ (USA)). 11 Apr 1977. Contract AC03-76SF01123. 149p. NTIS, PC A07/MF A01.

The design and performance of the radial compressor stage of the rotating unit for an isotope-fueled Brayton cycle power system for space vehicles are described, and test results for both the original and redesigned compressors are presented. (LCL)

30084 **(DOE/SF/01123—T51) Brayton isotope power system design integrity checklist (BIPS-DIC).** Miller, L.G. (AiResearch Mfg. Co., Phoenix, AZ (USA)). 15 Feb 1977. Contract AC03-76SF01123. 15p. NTIS, PC A02/MF A01.

A preliminary Failure Modes, Effects and Criticality Analysis (FMECA) for the Brayton Isotope Power System (BIPS) Flight System (FS) was published as AiResearch Report 76-311709 dated January 12, 1976. The FMECA presented a thorough review of the conceptual BIPS FS to identify areas of concern and activities necessary to avoid premature failures. In order to assure that the actions recommended by the FMECA are effected in both the FS and the Ground Demonstration System (GDS), a checklist (the BIPS-DIC) was prepared for the probability of occurrence of those failure modes that rated highest in criticality ranking. The BIPS-DIC was revised. Additional entries were added which raferenced failure modes determined to rank highest in criticality ranking according to FMECA of the BIPS-GDS. The current revision provides the latest status (as of February 1977) of actions to eliminate or minimize the areas of concern. One additional area of concern, that of possible leakage resulting from grain boundary deterioration, has been included. Confidence exists that conservative design techniques complemented by effective quality assurance and reliability programs will reduce possible failure modes to extremely low probabilities.

30085 **(DOE/SF/01123—T55) Isotope Brayton ground demonstration testing and flight qualification program. Volume 1. Technical program.** (AiResearch Mfg. Co., Phoenix, AZ (USA); General Electric Co., Philadelphia, PA (USA). Space Div.). 9 Dec 1974. Contract AC03-76SF01123. 184p. NTIS, PC A09/MF A01. Order Number DE81026736.

A proposal for the demonstration, development and production of the Isotope Brayton Flight System for space vehicles is presented with details on the technical requirements for designing and testing a ground demonstration system and on the program organization and personnel. (LCL)

30086 **(DOE/SF/01123—T56) Proven reliability of the gas-turbine engine. BIPS Phase 1.** (AiResearch Mfg. Co., Phoenix, AZ (USA)). Nov 1976. Contract AC03-76SF01123. 27p. NTIS, PC A03/MF A01.

The background, capabilities and experience of the Garrett Corp. in designing, developing, manufacturing and testing gas turbines and related systems are described, and the requirements for and components of the Brayton Isotope Power System (BIPS) for space vehicles are outlined. Data on the compressor and turbine, alternator, bearings, recuperator, radiator, heat source assembly, and control systems are presented. (LCL)

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 30784

30087 **Water gas shift reaction: homogeneous catalysis by ruthenium and other metal carbonyls.** Ford, P.C. (Univ. of California, Santa Barbara). *Accounts of Chemical Research ;* **14**: No. 2, 31-37(Feb 1981).

A number of chemical systems are active for homogeneous, solution phase catalysis of the water gas shift reaction (WGSR). Catalysis of the shift reaction appears to be a quite general property of carbonyl complexes in alkaline solutions. The key mechanistic steps for which some kinetics information is available are the activation of coordinated CO by reaction with hydroxide and the reductive elimination of dihydrogen from a resulting metal hydride. Which of these is rate limiting in a cycle is a function of the specific metal system and the specific reaction conditions. A basic solution is not a necessary condition for WGSR catalysis. Although WGSR catalysis is not as general a phenomenon in acidic media, several such systems have been characterized with activities which compare very favorably to those seen in basic solutions. While logical mechanisms have been proposed for several of the better characterized catalysts, it is clear that a more complete mechanistic understanding of the key steps in potential cycles is greatly needed. Recognition of such needs has led to fundamental studies into the acid/base natures of metal carbonyl hydride clusters, of CO activation on cluster and mononuclear metal carbonyls by bases, and of

dihydrogen elimination from and declusterification and clusterification reactions of metal carbonyl hydrides. While none of these processes is in itself catalytic, the sum of several represents possible cycles. With regard to the future of homogeneous WGSR catalysts, it is obvious that under the conditions which these have been tested, the known systems are not commercially viable. Certainly, for a reaction such as the WGSR for which effective heterogeneous catalysts are known, it will take substantial advantages for a new system to be an attractive alternative to established technology.

30088 **(DOE/ER/06034—3) Energy conversion based on molecular excited states. Progress report, August 1, 1980-July 31, 1981.** Meyer, T.J. (North Carolina Univ., Chapel Hill (USA). Dept. of Chemistry). 1981. Contract AS05-78ER06034. 8p. NTIS, PC A02/MF A01. Order Number DE81028940.

Progress is summarized on: properties of Os complexes, preparation of a polymeric complex, mechanistic studies of photochemical intermediates, oxidation of water catalyzed by $Ru(bpy)_2(H_2O)_2^{2+}$, and development of excited-state photoelectrochemical cells. (DLC)

30089 **(PB—81-123473) Thermochemical water splitting for hydrogen production. Annual report, 1 January-31 December 1979.** Besenbruch, G.E.; O'Keefe, D.R.; Norman, J.H. (General Atomic Co., San Diego, CA (USA)). Feb 1980. Contract GRI-5014-323-0122. 117p. NTIS, PC A06/MF A01.

Investigation of the sulfur-iodine process at General Atomic Company (GA) continued during 1979. The major accomplishment for this year was the incorporation of most of the process improvements, developed under the Gas Research Institute (GRI)/GA-sponsored chemistry investigation program, into the engineering flow sheet, resulting in a process thermal efficiency of 47 percent. The effort has centered principally on six areas: (1) Investigation of the thermodynamics of the main solution reaction (2H2O + SO2 + xI2 - 2HIx + H2SO4) to develop a model of the system. (2) Investigation of the H2SO4 boost reaction to increase the yield of sulfuric acid from the main reaction. (3) Support of the flow sheet effort to incorporate chemistry process improvements into the process. (4) Investigation of decomposition of hydrogen iodide in the liquid phase. (5) Investigation of vapor pressures and solubilities associated with the lower phase process mixtures and other HI/I-containing process liquids. (6) Investigation of the gas-liquid phase relationships resulting from treatment of the lower phase. The results achieved in these areas are described in detail in this report.

30090 (SERI/CP—633-1145, pp 51-55) **Solar thermal hydrogen production process.** Parker, G.H. (Westinghouse Advanced Energy Systems Division, Pittsburgh, PA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

A hybrid thermochemical-electrochemical process for the production of hydrogen and oxygen from water is being developed. The production of oxygen occurs via the thermal reduction of sulfur trioxide obtained for sulfuric acid. The sulfur dioxide thus produced then reacts electrochemically with water to produce hydrogen and sulfuric acid. The status of the program is described. A pressurized test unit (PTU) has been conceptually designed and sized, and research and development on critical components of the cycle is being done. Candidate materials for the acid vaporizer and the reduction reactor have been exposed to boiling sulfuric acid or acid vapor to determine corrosion resistance. Candidate catalysts for accelerating the oxygen-producing reaction have also been tested by exposure to vaporized sulfuric acid. The development of the electrolyzer is also described. The long-range goal for the electrolyzer is to obtain a stable cell voltage less than 600 mV at 200 mA/cm^2 while the electrolyzer is operated at about 100°C and 20 atm, using 50 to 60 w/o sulfuric acid solutions. (LEW)

30091 **Thermochemical process for recovering Cu from CuO or CuO2.** Bamberger, C.E.; Richardson, D.M. (to Department of Energy). US Patent 4,259,108. 31 Mar 1981. Filed date 31 May 1979. vp.

PAT-APPL-044788.

A process for producing hydrogen comprises the step of reacting metallic Cu with $Ba(OH)_2$ in the presence of steam to produce hydrogen and $BaCu_2O_2$. The $BaCu_2O_2$ is reacted with H_2O to form Cu_2O and a $Ba(OH)_2$ product for recycle to the initial reaction step. Cu can be obtained from the Cu_2O product by several methods. In one embodiment the Cu_2O is reacted with hf solution to provide CuF_2 and Cu. The CuF_2 is reacted with H_2O to provide CuO and hf. CuO is decomposed to Cu_2O and 0_2. The hf, Cu and Cu_2O are recycled. In another embodiment the Cu_2O is reacted with aqueous H_2SO_4 solution to provide $CuSO_4$ solution and Cu. The $CuSO_4$ is decomposed to CuO and SO_3. The CuO is decomposed to form Cu_2O and O_2. The SO_3 is dissolved to form H_2SO_4. H_2SO_4, Cu and Cu_2O are recycled. In another embodiment Cu_2O is decomposed electrolytically to Cu and O_2. In another aspect of the invention, Cu is recovered from CuO by the steps of decomposing CuO to Cu_2O and O_2, reacting the Cu_2O with aqueous hf solution to produce Cu and CuF_2, reacting the CuF_2 with H_2O to form CuO and hf, and recycling the CuO and hf to previous reaction steps.

30092 **Hydrogen production by the decomposition of water.** Bowman, M.G.; Hollabaugh, C.M. (to Department of Energy). US Patent 4,244,794. 13 Jan 1981. Filed date 31 Jul 1979. vp.

PAT-APPL-062373.

How to produce hydrogen from water was a problem addressed by this invention. The solution employs a combined electrolyticalthermochemical sulfuric acid process. Additionally, high purity sulfuric acid can be produced in the process. Water and SO2 react in electrolyzer (12) so that hydrogen is produced at the cathode and sulfuric acid is produced at the anode. Then the sulfuric acid is reacted with a particular compound mrxs so as to form at least one water insoluble sulfate and at least one water insoluble oxide of molybdenum, tungsten, or boron. Water is removed by filtration; and the sulfate is decomposed in the presence of the oxide in sulfate decomposition zone (21), thus forming SO3 and reforming mrxs. The mrxs is recycled to sulfate formation zone (16). If desired, the SO3 can be decomposed to SO2 and O2; and the SO2 can be recycled to electrolyzer (12) to provide a cycle for producing hydrogen.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 29875, 29942, 30106, 30131, 31061, 31303

30093 **(DOE/CS/20300—1) Enhancement of methane production in the anaerobic digestion of municipal sewage sludge.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC01-76CS20300. 151p. NTIS, PC A08/MF A01. Order Number DE81027246.

The effect of powdered activated carbon and other additives on digester performance is evaluated in this report. The objectives of the project include optimizing the carbon addition process for maximum methane production, identifying ancillary benefits, establishing design criteria for application at full-scale facilities, assessing technical and economic feasibility, and estimating the impact of the technology on a nationwide basis. These objectives are being accomplished through a series of bench-scale experiments, pilot plant studies, and field demonstrations. Results indicate that the actual feasibility of carbon addition will depend largely on the individual circumstances at sewage treatment plants. Application of the carbon addition technique would produce beneficial effects only at those sites where digesters are operating poorly. The effect of carbon on sludge handling and transport costs, as well as on methane production, must be included in any feasibility study. It seems apparent that carbon addition should be considered at facilities where digesters are stressed, and implementation may be desirable in some cases. Due to rising natural gas and chemical prices, the economics of carbon addition may become much more attractive during the next few years.

30094 (DOE/CS/20549—T1) Solid-waste and biomass low-Btu gas-conversion-system program. Topical report, Task 2. Site selection and analysis. (California State Government, Sacramento (USA); Alpha National, Inc., El Segundo, CA (USA)). 31 Oct 1979. Contract FC03-79CS20549. 84p. NTIS, PC A05/MF A01. Order Number DE81028747.

The purpose of this program is to test 2 low Btu gas turbines at Glendale's Scholl Canyon Landfill and Los Angeles' Hyperion Waste Water Treatment Plant. Each of these sites is unique and different in terms of the gas generation and collection systems. Glendale's Scholl Canyon Sanitary Landfill is in the process of being converted into a recreational park with a golf course, tennis courts, and a clubhouse. The gas wells are located in the golf course area of the landfill. The Hyperion plant generates gas by the digesting of sewage sludge. The purpose of this task is to perform a site definition and test program analysis. The goal of the site definition is to provide: (1) the specific details of the turbine location and required electrical and gas interfaces for each test site; and (2) the test plan to be used in task 8. In addition, a review of necessary permits, licenses, or other approvals required by federal, state and local authorities, including all environmental requirements was made. Finally a determination was made of any local ordinances or state statutes that must be revised to operate and test the proposed turbogenerator. These topics relating to site selection and analysis are discussed. The appendix contains an Air Pollution Source Manual. (DMC)

30095 (DOE/CS/20549—T2) Solid-waste and biomass low-Btu gas-conversion-system program. Topical report, Task 1: problem definition. (Alpha National, Inc., El Segundo, CA (USA)). 28 Sep 1979. Contract FC03-79CS20549. 157p. NTIS, PC A08/MF A01. Order Number DE81028748.

The design philosophy, turbine specifications, gas generation technology and characterization, and fuel specifications for testing are reviewed. (MHR)

30096 (PB—81-851974) Thermochemical processes in biomass conversion. January 1976-July 1980 (citations from the Energy Data Base). Report for January 1976-July 1980. Frey, J.H. (New England Research Application Center, Storrs, CT (USA)). Aug 1980. 90p. NTIS PC N01/MF N01.

This retrospective bibliography contains citations concerning chemical reactors and thermochemical processes in biomass conversion of agricultural wastes, forestry wastes, and other organic wastes from human activity for fuel and energy production. It covers research, development, and applied technology. (Contains 72 citations.)

30097 (PB—81-851982) Biosynthesis in biomass conversion. January 1976-July 1980 (citations from the Energy Data Base). Report for January 1976-July 1980. Frey, J.H. (New England Research Application Center, Storrs, CT (USA)). Aug 1980. 158p. NTIS PC N01/MF N01.

This retrospective bibliography contains citations concerning fuel and energy production by bioconversion of organic waste materials from agriculture, forestry, and other human activities. It covers research, development, and applied technology pertaining to biosynthesis in biomass conversion. (Contains 143 citations.)

30098 (PB—81-855181) Methane from waste. June 1970-June 1980 (citations from the Engineering Index Data Base). Report for June 1970-June 1980. Ogushwitz, H.L. (New England Research Application Center, Storrs, CT (USA)). Jun 1980. 149p. NTIS PC N01/MF N01.

Cited articles include a discussion of the production of methane and other fuels from organic waste, sewage, manure and other wastes. (Contains 133 citations.)

30099 Commercial applications of reactions catalyzed by soluble complexes of cobalt and rhodium. Parshall, G.W. (E.I. du Pont de Nemours & Co., Wilmington, DE). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 107-124(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

Twenty-seven major processes catalyzed by soluble transition metal catalysts are listed in this article. Oxidation reactions are a major component of homogeneous catalysis technology. Cobalt is the most prevalent catalytic metal. It is widely used in the oxidation of hydrocarbons as well as in CO reactions. Of the metals in the second transition series, rhodium is most prevalent. It is replacing cobalt in many CO reactions and has many potential applications. In this paper, the author explores the applications of cobalt complexes in catalysis of oxidation and carbonylation reactions. Carbon monoxide reactions, especially hydrocarboxylation, are also discussed. Speculative applications of cobalt and rhodium catalysts are briefly presented. (DMC)

30100 Catalytic synthesis of hydrocarbons over group VIII metals. A discussion of the reaction mechanism. Bell, A.T. (Lawrence Berkeley Lab., CA). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 203-232(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

The Fischer-Tropsch synthesis, the nonselective generation of organic compounds via the hydrogenation of CO, is discussed in regard to how catalyst composition and reaction conditions govern the distribution of products formed. Mechanistic hypothesis of this reaction are reviewed. Recent theories suggest that nonoxygenated intermediates play a dominant role in the synthesis of hydrocarbons and that this synthesis is initiated by dissociation of CO and that the carbon atoms thus produced are hydrogenated to form adsorbed methylene and methyl groups. Evidence leading to this view of Fischer-Tropsch synthesis is presented. The participation of olefins in secondary reactions is also discussed. (DMC)

30101 Technological perspective for catalytic processes based on synthesis gas. King, D.L.; Cusumano, J.A.; Garten, R.L. (Catalytica Associates, Inc., Santa Clara, CA). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 233-263(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

There is a growing interest in the production and use of synthesis gas as a feedstock for the manufacture of fuels and chemicals. Most of the proposed routes are catalytic in nature, and are directed at overcoming the limitations of Fischer-Tropsch chemistry, especially selectivity. Over the past several years, research efforts have led to new selective routes to various fuel fractions; to petrochemical feedstocks including light olefins and various aromatics; to commodity chemicals such as ethylene glycol, ethanol, and acetic acid; and to a number of other fuels and chemicals. Although the chemistry and catalysis for many of these new routes look promising, there are still a number of technical challenges to be met before they are commercially viable. Innovations in both homogeneous and heterogeneous catalysis will play an important role in meeting these challenges. In this overview, some of the key technical problems of synthesis-gas chemistry are reviewed, and a perspective is provided for the directions of synthesis-gas technology over the next decade. The following subjects are discussed: motivation for research in synthesis gas chemistry; synthesis gas as a feedstock; limitations on technical technologies; the nature of the selectivity problem; and approaches to circumvent the selectivity limitations in CO/H_2 reactions-i.e. limitation of chain growth by pore size, interception of intermediates during synthesis, chemical modifications of catalysts, and development of catalysts.

30102 Technology of the Fischer-Tropsch process. Dry, M.E.; Hoogendoorn, J.C. (Sasol Ltd., Sasolburg, South Africa). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 265-278(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

The process followed by Sasol in the production of liquid fuels from coal is briefly described. Synthesis gas is produced via Lurgi coal gasification and hydrocarbons are synthesized via Fischer-Tropsch process. The technology of the Fischer-Tropsch synthesis as utilized at the Sasol I & II plants is described. The present technology of the Fischer-Tropsch reaction over iron catalysts using fluid-bed and/or fixed-bed reactors gives a fully developed commercial route for the production of a wide range of commod-

ities ranging from light olefins to commercial alcohols to heavy hydrocarbons, where for a given market situation the combination of catalyst composition, operating, conditions, reactor type, and refinery system can be selected to give optimum economic results. In most cases this optimum will be reached when the supply of ethylene and propylene can be combined with sales of SNG and transport fuels such as gasoline, jet fuel, and diesel oil.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 29907, 30096, 30097, 30131, 30152, 30394, 30395, 30498, 30785

30103 **(DOE/ET/23141—T3) Hawaii ethanol from molasses project. Report on plant inspections.** Gibson, W.O.; Mashima, K.I.; Roberts, R.R.; Chen, C.S. (Hawaii Univ., Honolulu (USA). Center for Engineering Research). 18 Sep 1979. Contract AC03-79ET23141. 12p. NTIS, PC A02/MF A01. Order Number DE81029370.

Personal inspections were made of several ethanol plants in Europe and the US in order to determine the best commercial processes presently in operation, prepare a conceptual design of a large plant incorporating these processes, describe the processes, and list best estimates of yields, energy requirements, capital costs and operating costs. Information was obtained from fermentation plant manufacturers and alcohol producers concerning their company-sponsored process improvement and new process developments. A summary of the highlights of these observations are included in this report. The inspectors: observed commercial incineration of waste sulfite liquors; observed the pilot plant (not in operation) to incinerate various waste liquors resulting from fermentation of different feedstocks; observed commercial continuous and batch fermentation of beet molasses for the production of ethanol and stillage evaporation to 70% dissolved solids for animal feed; observed pilot plant operation of a new process (Carver-Greenfield process) for handling stillage; observed anhydrous ethanol production from fermentation of sulfite waste liquor using ethyl ether as the dehydrating agent; and observed the safety precautions taken when using this hazardous material.

30104 **(DOE/PC/30239—T2) Mechanistic study of catalytic methanol synthesis. Progress report.** Kung, H.H. (Northwestern Univ., Evanston, IL (USA)). 10 Aug 1981. Contract FG22-80PC30239. 6p. NTIS, PC A02/MF A01. Order Number DE81028915.

Progress is reported on the elementary kinetics and mechanisms involved in the production of methanol by means of the hydrogenation of carbon monoxide. The relative rates of reaction were determined by means of the relaxation technique. Advancement in the understanding of mixed oxide catalysts was also made during the quarter.

30105 **Crystal and molecular structure of $Co_3(CO)_9CO$: a possible intermediate in the reduction of CO.** Adams, H.N.; Fachinetti, G.; Straehle, J. *Angewandte Chemie, International Edition in English ;* **20**: No. 1, 125-126(Jan 1981).

For x-ray structure analysis, solvent-free $Co_3(CO)_9COH$ was prepared by acidification of $LiCo_3(C0)_{10}$. The three Co atoms form a regular triangle which is completed to a tetrahedron by an apical CO group. The C-O bond length of the apical CO group is 1.33(1)A, indicating that the H atom is bonded to the O atom of the apical CO group. Short intermolecular O-O distances between the apical O atoms of two neighboring clusters indicate intermolecular hydrogen bridges. $Co_3(CO)_9COH$ is suggested as a model and a possible intermediate hydrogenation of CO to methanol in homogeneous phase. (DLC)

30106 **Catalytic hydrogenation of carbon monoxide. The formation of C_1 hydrocarbons.** Somorjai, G.A. (Univ. of California, Berkeley). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 189-202(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

Both the production of methane and methanol from CO and H_2 are important processes in chemical technology. The catalytic reactions that produce these two molecules are described in this article. The kinetics and mechanisms of these reactions, the catalytically active surface, and the nature of the surface chemical bond of CO, H_2, and the reaction intermediates are reviewed. The effect of alkali promoters on the CO/H_2 reaction is discussed.

0903 Inorganic Hydrogen Compound Fuels

REFER ALSO TO CITATION(S) 30099

30107 **Ammonia synthesis: exploratory and applied research.** Nielsen, A. (Haldor Topsee A/S, Copenhagen, Denmark). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 17-51(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

The bulk structure and surface composition of promoted ammonia catalysts such as are used today in industry are described in this paper. The improvement of such catalysts and the development of other types of catalysts for ammonia production are also discussed. Catalysts having ruthenium, rather than iron, as the active metal are evaluated. Some aspects of ammonia catalysis directly linked to the optimization of the process are presented. (DMC)

30108 **Technology of ammonia plants.** Axelrod, L. (Pullman Kellogg Co., Houston, TX). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 53-65(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

There is an expanding market for ammonia plants because population keeps growing and there is a continuing demand for improved per capita nutrition. The rate of growth of production is limited by social, economic, and political factors which are difficult to predict. The predominant feedstock in the near future will continue to be natural gas with coal beginning to encroach. Flowsheet, catalyst, and mechanical development will continue to reduce energy expenditures. Beyond the next few years, changes will be seen which are difficult to imagine today. The 165 ton-a-day ammonia plant at Ventura was a large plant in its day. A few years later, in 1956, Pullman Kellogg Company designed and built what was then the largest single-train plant in the world-300 tons a day-and went on from there to the 1000, 1500, and 2000 ton-a-day plants of today. Processes used in the production of ammonia are described. Alternate feedstocks such as biomass are also discussed in this article.

30109 **Molecular metal clusters as catalysts.** Muetterties, E.L. (Univ. of California, Berkeley). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 69-87(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

Differences in reactivity between metal surfaces and metal clusters are discussed in this article. The catalytic hydrogenation of CO is explored in regard to questions about model reactions or intermediates in molecular metal clusters. A class of coordinately unsaturated metal clusters (polynuclear rhodium hydrides) was discovered by accident. The significance of this discovery lies in the mechanistic information to be gained about reaction sequences in clusters in which contiguous metal atoms are involved and in the possible insights provided by analogy to mechanistic features of similar reactions that proceed on metal surfaces. Intermediates in CO hydrogenation reactions are described.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 30096, 30097

30110 **Emissions of oxides of nitrogen from boilers fired with wood and bark residue fuels.** Junge, D.C. (Oreg State Univ, Corvallis). *Tappi ;* **64**: No. 3, 163-165(Mar 1981).

Under a research program funded by the U.S. Department of Energy, data were collected on the emissions of oxides of nitrogen from combustion of wood and bark residue fuels in an industrial spreader-stoker pilot test facility. Twenty-eight tests with eastern

white pine bark and 105 tests with Douglas fir bark were carried out with known levels of excess air. The data collected were compared with data collected in full-scale industrial boiler emission tests. Wide variations in the nitrogen content of the fuels and in the emission levels of oxides of nitrogen were found. Attempts to correlate measured levels of NO/sub x/ with levels of excess air, undergrate air:fuel ratios, combustion chamber temperatures, and fuel feed rates did not produce any useful information. Information is presented which shows how to convert measured levels of NO/sub x/ in parts per million into emission rates in units of tons/year.

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 30651, 30770

30111 **(CONF-8106137—2) DOE Small-Hydropower Demonstration Program.** Rinehart, B.N.; Felton, L.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1981. Contract AC07-76ID01570. 15p. NTIS, PC A02/MF A01. Order Number DE81027819.

From WATERPOWER 1981 conference; Washington, DC, USA (22 Jun 1981).

Knowledge gained from the Department of Energy's Small Hydropower Demonstration Program is presented. These 20 small hydroelectric developments across the country are at various stages of licensing, financing, construction, and operation. Their methods and experiences are detailed in order to show what can be done in the real world of small hydropower development.

30112 **Conservationists cause hesitation in development of Swedish hydroelectric power.** *Electrical Review International ;* **208**: No. 5, 64-65(6 Feb 1981).

Sweden's present hydro-electric power output is 62TWh/year (approximately 65% of Sweden's electrical generation), and there is an economically feasible potential of 33TWh/year to be developed, most of which is in the Norbotten area, bordering on Swedish Lapland. More than 15TWH of the power to be developed would come from four rivers in the area - the Vindel, Pite, Torne, and Kalix, but resistance by Swedish nature conservancy organizations to further development of hydro power has stopped plans for development. The conservation movement in Sweden and how it affects hydro-electric power development is discussed, along with planned hydro-electric developments. (JMT)

1301 Resources And Availability

REFER ALSO TO CITATION(S) 30114

30113 **(DOE/TIC—1029964) Hydropower sites of the United States developed and undeveloped: river basin maps showing site locations (conventional, pumped storage, retired).** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Jan 1981. vp. GPO $127.00. Order Number DE81029964.

The Federal Energy Regulatory Commission, utilizing resources of the Energy Information Administration, including computer and data handling facilities, maintains a comprehensive inventory of hydropower sites in the United States, both developed and undeveloped. The information is used in carrying out the Commission's responsibilities for licensing hydroelectric projects and reviewing project proposals of other Federal agencies. During the past two years, the location code system has been revised and the inventory has been expanded considerably to include smaller undeveloped sites. This publication is its result of compiling and organizing the expanded inventory data in a comprehensive Atlas of hydropower sites. It is the first such Atlas published in the United States. This Atlas identifies the location of about 8100 hydropower sites in the United States by means of a river basin and site coding system for organizing information on the hydroelectric power resources of the County. About 5300 of the sites have been plotted on a series of 85 maps. Retired plant sites are also included. Seventy-nine of these maps covering the conterminous United States are included in the body of this Atlas and six maps covering Alaska, Hawaii, and Puerto Rico are included in attached envelopes.

1302 Site Geology And Meteorology

REFER ALSO TO CITATION(S) 30652

1303 Plant Design And Operation

REFER ALSO TO CITATION(S) 30656

30114 **(CONF-8106137—1) Modular hydro dam approach to the economic development of ultra low-head hydropower.** Broome, K.R. (Gilbert Associates, Inc., Reading, PA (USA)). 1981. Contract AC07-76ID01570. 19p. NTIS, PC A02/MF A01. Order Number DE81027817.

From WATERPOWER 1981 conference; Washington, DC, USA (22 Jun 1981).

The solution to developing economical ultra low-head (10 ft. -6 ft., 3m-2m hydrpower lies in being able to reduce equipment and construction costs at new dams to less than $4000/KW, while maintaining an operating efficiency of 80% or more. The purpose of this investigation was to explore the potential for developing economical new ultra low-head sites using an innovative concept known as the Modular Hydro Dam (MHD). This concept, combines the benefits of shop fabrication and installation of equipment in truck transportable, waterproof power modules, with prefabricated gate sections that can be located between the power modules. Lateral support to withstand the static head pressure is provided by an upstream tension cable system anchored at each bank. Foundation design for vertical support varies with subsurface conditions. The technical, economic, environmental, and institutional feasibility of the MHD concept were examined. The module selected contains an axial-flow type turbine, rated at 300 kW under a 10-ft head, a generator driven by a belt drive, vertical intake gate, and electrical control system and switchgear. Capital and operating costs are estimated. It is concluded that the US potential for power generation at ultralow-head sites justifies the development of the MHD concept, and that a full scale demonstration of the concept could be completed by 1986. (LCL)

30115 **(EPRI-EM—1589-Vol.2) Preliminary design study of underground pumped hydro and compressed-air energy storage in hard rock. Volume 2. Project design criteria: UPH. Final report.** (Potomac Electric Power Co., Washington, DC (USA); Acres American, Inc., Columbia, MD). May 1981. Contract AC02-77ET28013. 185p. NTIS, PC A09/MF A01. Order Number DE81028107.

This volume documents the design criteria for an underground pumped hydroelectric (UPH) storage facility having a maximum generating capacity of 2000 MW and a storage capacity of 20,000 MWh at a nominal head of 5000 ft. The UPH facility is a two step configuration with single-stage reversible pump-turbines, each step consisting of a 1000 MW plant at a nominal head of 2500 ft. Overall design criteria including operating requirements, civil/structural criteria, geotechnical criteria, mechanical criteria and electrical criteria are detailed. Specific requirements are given for the upper reservoir, intake/outlet structure, penstock and draft tubes, powerhouses, transformer galleries, intermediate reservoir, lower reservoir, shafts and hoists, switchyard and surface buildings. The requirements for the power plant electrical and mechanical equipment, including pump-turbine and motor-generator units, are referred to. Electrical design criteria are given to meet the requirements of two power-houses located underground at different depths, but these criteria may not necessarily reflect PEPCO's current engineering practice. It should be noted that the design of criteria given in this volume relate to the two step UPH storage facility arrangement selected during the Design Approaches phase of the study as described in Volume 8, Design Approaches - UPH. The criteria refer to a specific site and take into account the site investigation work described in Volume 6, Site Investigation - Shallow Drilling and in Volume 7, Site Investigation - Deep Drilling. The design criteria given were used as the basis for the plant design set out in Volume 11, Plant Design -UPH.

1305 Economics And Management

30116 **(PB—81-117244) Analysis barriers to improving the hydroelectric power interface with electric power systems. Final report.** (Resource Analysis, Inc., Waltham, MA (USA)). 30 Sep 1980. Contract DI-14-34-0001-9625. 95p. NTIS, PC A05/MF A01.

The analysis barriers to improving the interface of hydroelectric power with electric power systems are investigated and discussed. The value of hydropower to society and the utilities is explored touching on the problems of weather and hydrological dependencies, multiple-use conflicts and engineering aspects. Special attention is afforded to the organizational structure of the electric utility industry and the operational and planning functions as they relate to hydroelectric power production. Analytical approaches taken to optimize the use of hydropower over time are surveyed. Current barriers to these approaches are presented along with future research topics which potentially may alleviate them.

1307 Power Conversion Systems

30117 **(EGG-M—03381) Innovative equipment for small-scale hydro developments.** Lawrence, J.D.; Pereira, L. (EG and G Idaho, Inc., Idaho Falls (USA); Acres American, Inc., Buffalo, NY). 1981. Contract AC07-76ID01570. 17p. (CONF-8106137—4). NTIS, PC A02/MF A01. Order Number DE81027820.

From WATERPOWER 1981 conference; Washington, DC, USA (22 Jun 1981).

Manufacturers of mechanical and electrical equipment for small-scale hydro developments have placed much emphasis in recent years on cost reductions obtainable through standardization and package units. More recently, the concept of using off-the-shelf design pumping equipment in the turbine mode is receiving increased attention in the industry. The results of a recently completed study undertaken to investigate the feasibility of using off-the-shelf pumps as turbines, with induction motors as generators, and other appropriate combinations of available equipment such as speed increasers, inlet valves, and gates for typical small-scale hydro installations are discussed. No actual tests were undertaken. However, a computer simulation model was developed in the study which provides a useful basis to estimate the performance of pumps in the turbine mode of operation. Detailed technical and economical investigations indicate that a major part of the small hydro plant potential can be economically covered by the use of pumps as turbines and induction motors as generators especially for the smaller ratings. The computer simulation model developed to predict turbine performance from pump performance curves is a useful tool for preliminary selection of suitable pumps. This is, however, not intended to be a tool or a substitute for model tests which need to be done by manufacturers when basic pump modifications are contemplated with the view to improve efficiency and performance when run as turbines. The investigations are a step in the right direction for the economical use of pumps as turbines in small hydro plants.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 30770

30118 **(CONF-801178—) SOLTECH 80.** (Arabian Exhibition Management Ltd., Manama (Bahrain)). 1980. 174p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE81901931.

From SOLTECH conference; Bahrain, Bahrain (10 Nov 1980).

Nine papers are included. A separate abstract was prepared for each one. (MHR)

1401 Resources And Availability

30119 (CONF-801178—, pp 24p, Paper 1) **Solar program of the Research Institute/UPM.** Nimmo, B.; Dabbagh, A.; Said, S. (Univ. of Petroleum and Minerals, Dhahran, Saudi Arabia). 1980. NTIS (US Sales Only), PC A08/MF A01.

From SOLTECH conference; Bahrain, Bahrain (10 Nov 1980).

Projects are described and results presented for three of the solar related activities presently underway: Solar Radiation Monitoring, Effects of Dust Accumulation on Collector Performance, and Salt Gradient Solar Pond Analytical and Experimental Studies. Measurements of total horizontal and direct radiation have been made continuously since May, 1979 and the data are presented in a user oriented format on an hourly basis. These results have been extended by calculation to allow presentation on an hourly basis of diffuse radiation and total radiation on a surface tilted to the local latitude angle. The system is presently being expanded to allow measurement of several additional radiation parameters of interest as well as six meteorological parameters. Some results are presented to show the effects of atmospheric dust on radiation attenuation, as well as the clearness index, anti K/sub T/. Results are also presented for a related study, the impact of surface dust accumulation on the performance of photovoltaic and thermal collectors. Continuous monitoring of the peak watt output of a small photovoltaic panel during a period which included severe dust storms showed a decrease in performance of sixty percent (60%) relative to the clean panel output. Settling of dust on the surface of a solar pond does not, on the other hand, appear to be a problem. The salt gradient solar pond work is proceeding on two fronts: analytical and experimental. Preliminary results are presented for a varying property transient one dimensional computer model currently being used in design studies. Preliminary experimental results are also presented for temperature profiles measured in our small prototype pond.

30120 **Algorithm for calculating monthly-average radiation on inclined surfaces.** Klein, S.A.; Theilacker, J.C. (Univ of Wis, Madison). *Transactions of the ASME (American Society of Mechanical Engineers)* ; **103**: No. 1, 29-33(Feb 1981).

An analytical method is developed for estimating the ratio of the long-term monthly-average daily radiation on an inclined surface to that on a horizontal surface. This method differs from the Liu and Jordan method in the manner in which the beam radiation component is determined. The method is applicable for surfaces of any orientation. 14 refs.

1403 Economics

REFER ALSO TO CITATION(S) 30233, 30266

30121 (CONF-790346—, pp 10p, Paper 16) **Economic analysis: a design tool.** Bucalo, S.P. 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

A general discussion of energy supplies, consumption, and trade deficit of the US is given. It is then pointed out that designing energy systems that maximize energy saving per invested dollar will contribute toward a reduction in the energy trade deficit. The function of economic analysis as an effective tool in optimizing the design of three solar panel configurations providing about 60, 70, and 75% of a facility's heating is demonstrated. (MCW)

30122 (CONF-790346—, pp 16p, Paper 17) **Economic feasibility and technical readiness of solar technologies.** Witholder, R.E. (Solar Energy Research Inst., Golden, CO). 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

A summary of the state of commercialization of solar technologies as indicated by technical readiness and economic feasibility is presented. These data are provided by market sector for solar thermal, wind energy conversion systems, photovoltaics systems, ocean thermal conversion system, and biomass technologies relative to the two indicators. (MCW)

30123 (DOE/CS/30278—T15) Solar technology assessment project. Volume I. State of solar energy technology (summary paper). Block, D.L. (Florida Solar Energy Center, Cape Canaveral (USA)). Apr 1981. Contract FC02-79CS30278. 27p. NTIS, PC A03/MF A01. Order Number DE81029002.

An overview assessment of the state of solar energy technology is presented, including economic considerations, problems/needs, and suggested government role. Solar technologies considered are passive heating and cooling; water heating and space heating and cooling; industrial process heat; photovoltaics; heliostat systems; wind; OTEC; and biomass. Also discussed are the solar industry and state and local government actions. Emphasis is placed on the federal government programs and the role of the federal government. In summary, it is anticipated that the photovoltaics, passive, biomass, hot water, space heating and wind programs are all within short term of the private marketplace. OTEC, heliostat systems, and industrial process heat are long-term R and D projects and will probably only reach the marketplace with federal support. Careful review of each solar program must be conducted each year with the purpose of minimizing federal funding and maximizing the placement of the technology in the private marketplace. Market opportunities for solar products are expected to expand significantly in 1981 and state and local governments possess the integrated approach and activities that will lead solar as rapidly as possible to the private market sector.

30124 (DOE/JPL—1060-47) SYSGEN user package. Carlson, C.R. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Mar 1981. Contract AT04-81AL16228. 125p. NTIS, PC A06/MF A01. Order Number DE81028372.

SYSGEN is a production costing and reliability model of electric utility systems. Hydro-electric, storage, and time-dependent generating units can be modeled in addition to conventional generating plants. The SYSGEN model and its links with other JPL simulations are described. Input variables, modeling options, output variables, and report formats are explained in detail and illustrated with examples. Sample computer output and instructions for running the program on an IBM batch system are appended. SYSGEN also can be run interactively by using a program developed at JPL called FEPS (Front End Program for SYSGEN). A format for SYSGEN input variables which is designed for use with FEPS is presented.

30125 (SERI/CP—633-1145, pp 139-144) **Regional assessment of solar thermal energy.** Witholder, R.E. Jr. (Solar Energy Research Inst., Golden, CO). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

The breakeven value and cost of solar thermal electric systems in the South Central, North Central, and Northwest regions of the United States are tabulated. The optimum situation is seen in the South Central Region. The other regions appear to have applications potential beyond the year 2000. The methods of value analysis for centralized and distributed systems are shown. (LEW)

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 30123

30126 (DOE/CS/30278—T8) Solar Technology Assessment Project. Volume XI. The solar industry in the United States: its status and prospects, 1981. Clark, J.A. (Florida Solar Energy Center, Cape Canaveral (USA); Michigan Univ., Ann Arbor (USA). Dept. of Mechanical Engineering). Apr 1981. Contract FC02-79CS30278. 47p. NTIS, PC A03/MF A01. Order Number DE81029030.

The energy production goals for the solar industry, and the industry's present status are described. Manufacturing and sales of low and medium temperature solar collectors from 1974 to 2000 are analyzed, and the HUD/DOE solar demonstration programs' relative merits are discussed. Certain characteristics of the conventional water heating industry are briefly described and compared with the solar water heating industry. Module and system cost data for the photovoltaics industry are summarized. Codes, standards, testing certification, labelling and warranties are discussed, and the government's role is defined. (LEW)

30127 (DOE/CS/30278—T14) Solar Technology Assessment Project. Volume XII. State and community commercialization issues. Doctor, R.D.; Hamrin, J. (Florida Solar Energy Center, Cape Canaveral (USA); Western Sun, Portland, OR (USA); Alliancke for Renewable, Sacramento, CA (USA)). Apr 1981. Contract FC02-79CS30278. 57p. NTIS, PC A04/MF A01. Order Number DE81029087.

The need to overcome economic and institutional barriers and make the transition to using renewable energy sources is briefly explained, and advantages to implementation of solar technology on the state and local government levels are discussed. The role of government involvement is defined, and the gathering and dissemination of information are discussed. Consumer protection programs are divided into 3 parts: problem prevention and detection; reliability assurance; and redress for problems. Each of these parts is discussed. Mandates, economic incentives, and subsidies are described and analyzed. (LEW)

30128 (WSUN—75) Oregon Solar Business Directory. (Western Solar Utilization Network, Portland, OR (USA); Oregon Solar Energy Industries Association, Portland (USA)). Apr 1981. Contract AC02-79CS30159. 36p. NTIS, PC A03/MF A01. Order Number DE81027700.

A current guide to renewable energy services and products available in Oregon is presented. A section on consumer buying tips is included to assist in planning the purchase and install installation of equipment. Also included is a list of information centers that carry publications about renewable energy technologies. (LEW)

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 30094, 30095, 30096, 30097, 30098, 30103, 30108, 30110, 30232, 30243, 30394, 30395, 31053

30129 (AD-B—028686/4) High temperature bonding techniques for solar cell array. Final report Mar 1976-Jun 1977. LaFontaine, G.; Marsh, F.; Levin, H.; Sinsheimer, F.; Wolff, G. (Hughes Aircraft Co., Los Angeles, CA (USA)). Nov 1977. Contract F33615-76-C-2032. 62p. NTIS, PC A04/MF A01.

An adhesive for solar cell attachment to spacecraft substrates has been sought with an unusually demanding combination of properties. These include (1) a basic resistance to decomposition at 600 C in vacuum, (2) retention of elastic properties at liquid nitrogen temperature, and (3) processibility as a bond line at conditions convenient to typical spacecraft fabrication. Of all the elastomeric materials available, the class of inorganic polymers termed poly (carboranesiloxanes) appears to be the only viable candidate. The ultrahigh molecular species of this group have been found to be attractive, especially when blended or alloyed with low molecular weight versions. This promising assessment is based on high temperature thermo-vacuum stability studies, various characterization measurements, elasticity measurements at cryogenic temperatures, and 45 peel studies of thermally cycled bond lines with varying adherend combinations.

30130 (DOE/CS/30278—T9) Solar Technology Assessment Project. Volume VI. Photovoltaic technology assessment. (Florida Technological Univ., Cape Canaveral (USA). FL Solar Energy Center; Arizona State Univ., Tempe (USA). Coll. of Architecture). Apr 1981. Contract FC02-79CS30278. 41p. NTIS, PC A03/MF A01. Order Number DE81029007.

Industrial production of photovoltaic systems and volume of sales are reviewed. Low cost silicon production techniques are reviewed, including the Czochralski process, heat exchange method, edge defined film fed growth, dendritic web growth, and silicon on ceramic process. Semicrystalline silicon, amorphous silicon, and low cost poly-silicon are discussed as well as advanced materials and concentrator systems. Balance of system components beyond those needed to manufacture the solar panels are included. Non-

technical factors are assessed. The 1986 system cost goals are briefly reviewed. (LEW)

30131 (DOE/CS/30278—T11) Solar Technology Assessment Project. Volume X. Solar technology assessment: biomass. Sheppard, A.P.; Birchfield, J.L; Spurlock, J.M. (Florida Solar Energy Center, Cape Canaveral (USA); Georgia Inst. of Tech., Atlanta (USA)). Apr 1981. Contract FC02-79CS30278. 59p. NTIS, PC A04/MF A01. Order Number DE81029011.

The technical status of various biomass fuels, and needed national action and research are summarized. Fuels discussed include biomass liquid fuels from agricultural feedstocks (alcohol), liquid fuels from cellulosic feedstocks, energy from wood, and non-woody biomass converted to gaseous fuels. (LEW)

30132 (DOE/ET/20404—T3) Amorphous-silicon solar cell. Quarterly report No. 1, 1 July 1976-30 September 1976. Carlson, D.E. (RCA Labs., Princeton, NJ (USA)). Oct 1976. Contract AC03-76ET20404. 26p. NTIS, PC A03/MF A01. Order Number DE81025745.

A conversion efficiency of 5.5% has been achieved, and the hole diffusion length is shown to be primarily responsible for limiting the conversion efficiency below the theoretical estimate of 17% for an ideal a-Si cell. Of the four different growth techniques being evaluated, the electroless discharge system seems to produce the best films. Substrates, growth conditions, and interfacial layers and various metal Schottky barriers are all under evaluation. Good reproducibility and correlation with electrical transport properties have been obtained. Schottky barrier cells exhibit near-ideal diode characteristics. (LEW)

30133 (DOE/ET/20407—T4) Heterostructure single-crystal-silicon photovoltaic cell. Type A, semiconductor heterojunction silicon devices. Annual report, September 28, 1976-November 30, 1977. Ghosh, A.K.; Feng, T.; Fishman, C. (Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Labs.). 1977. Contract AC03-76ET20407. 48p. NTIS, PC A03/MF A01. Order Number DE81027637.

The objective of the program is to perform an initial fabrication, testing, theoretical, and experimental study, which is necessary to prove and implement the technical and commercial practicability of the heterostructure single-crystal-silicon photovoltaic cell by 1980. Important electrical properties of the SnO_2/Si heterostructure solar cell are summarized, and the maximum theoretical and practically achievable efficiencies are computed. Fabrication of the solar cell is described, and electrical properties for eight cells prepared different ways are tabulated. The projected cost of single crystal p/n solar cells from ERDA studies are given and compared with those for SnO_2/Si cells. A paper by the authors entitled SnO_2/Si Solar Cells - Heterostructure or Schottky Barrier or MIS Type Device which presents the model of the cell and was submitted to the Journal of Applied Physics is appended. (LEW)

30134 (DOE/ET/20412—T2) Cadmium sulfide/copper ternary heterojunction cell research. Quarterly technical progress report, October 1, 1977-December 31, 1977. Mickelsen, R.; Selikson, B.; Chen, W. (Boeing Aerospace Co., Seattle, WA (USA)). Jan 1978. Contract AC03-77ET20412. 24p. NTIS, PC A02/MF A01. Order Number DE81029377.

$CuInSe_2$ film preparation and characterization and $CuInSe_2$/CdS conceptual model development are reported. Theoretical analysis has shown the dependence of $CuInSe_2$ film stoichiometry on the separation between the elemental source positions. Chemical analysis by scanning electron microprobe quantometer has revealed the stoichiometry variation to be less than a few percent across the 2 inch by 2 inch film. To reduce the stoichiometric variation across the film width, the film deposition system was modified to include a high temperature vapor homogenizer chamber. The three major carrier transport mechanisms across junction governing the I/V characteristics of the $CuInSe_2$/CdS cell are: 1) the Shockley diffusion mechanism, 2) recombination in the space charge region, and 3) recombination through interface states. Mechanism 1 is not expected in thin film heterojunctions. The diode I/V characteristics for interface state recombination has a diode ideality factor A equal to one, whereas $CuInSe_2$/CdS cells reported to date have a diode A factor of two, indicating space charge recombination. Changing the doping concentration of the $CuInSe_2$ would be a way of controlling recombination level involvement. This would lead to ideal A values and hence improved open circuit voltages.

30135 (DOE/ET/20414—T2) Cadmium sulfide/copper ternary heterojunction cell research. Technical progress report No. 1, September 30, 1977-December 31, 1977. (Sperry Univac, St. Paul, MN (USA). Defense Systems Div.). 1 Jan 1978. Contract AC03-77ET20414. 19p. NTIS, PC A02/MF A01. Order Number DE81027715.

A program was begun to develope a CdS/Copper Ternary heterojunction solar cell which can be reproducibly manufactured with an AM1 efficiency of no less than 8%, with a maximum electrical output degradation of 5% over 20 years. Two methods of depositing p-type $CuInSe_2$ films are being investigated - flash evaporation of p-type (Se rich) $CuInSe_2$ powder and a two-source (one Se rich) Electron Impact Emisson Spectroscopy controlled deposition. Progress reported includes the tooling of a flash evaporation apparatus. Devices fabricated in this apparatus with substrate temperature 200°C did not exhibit a photovoltaic effect. Extraneous phases in $CuInSe_2$ films were eliminated by depositing at higher temperatures. X-ray fluorescence of 200°C $CuInSe_2$ films idicated only 75% of the Cu required for stoichiometry, possibly because of Cu diffusion into metal electrodes. $CuInSe_2$ films have been deposited from .1% to 1% excess Se melts, resulting in p-type films. (LEW)

30136 (DOE/ET/21073—T1) Low-cost solar cells based on amorphous silicon electrodeposited from organic solvents. Technical quarterly progress report No. 3, March 1, 1979-May 31, 1979. Kroger, F.A. (University of Southern California, Los Angeles (USA). Dept. of Materials Science). 1979. Contract AT03-76ET21073. 29p. NTIS, PC A03/MF A01. Order Number DE81027707.

Electrolysis experiments were carried out using tetra ethyl ortho silicate plus propylene carbonate or 1-chloropropane or acetic acid or formamide and ammonium hexafluorosilicate plus formamide. These experiments yielded deposits which vary in color between white and black with greyish white, light or dark brown as intermediate colors depending on the deposition conditions. Energy dispersive x-ray analysis in the scanning electron microscope indicated the deposits to contain large concentrations of silicon; infra-red absorption and reflection studies showed bands characteristic of Si-O, Si-Cl, or Si-F vibrations and thus indicates the presence of these elements in the films. Determination of carrier type in doped deposits by hot point probe method was not successful.

30137 (DOE/ET/23033—T1) Defect states in plasma-deposited a-Si:H. Technical progress report, May-July 1979. Knights, J.C. (Xerox Palo Alto Research Center, CA (USA)). 21 Sep 1979. Contract AC03-79ET23033. 32p. NTIS, PC A03/MF A01.

Three preprints are presented. The first, entitled "Glow Discharge Optical Spectroscopy Measurement of Dopant Concentrations in a-Si:H," reports significant differences between the ratio of boron to silicon of the films and that of their deposition plasmas. The second, entitled "Growth Morphology and Defects in Plasma-Deposited a-Si:H Films," presents structural studies that show that a major class of defect is an anisotropic density fluctuation. Studies of the hydrogen environment suggest that an inhomogeneous hydrogen distribution is associated with these fluctuations. From considerations of the deposition chemistry and nucleation theory, a model is proposed to describe the film growth process and its relationship to defects. The third, entitled "Luminescence and ESR Studies of Defects in Hydrogenated Amorphous Silicon," demonstrates that the two experiments involve identical recombination transitions, and identify two separate processes. One process involves defect states, and from the doping dependence of light induced ESR, it is deduced that the electronically active defects are dangling bonds with positive electronic correlation energy. (LEW)

30138 (DOE/ET/23044—3) Deposition, fabrication, and analysis of polycrystalline-silicon MIS solar cells. Quarterly technical progress report No. 3, July 1, 1979-September 30, 1979. Anderson, W.A. (State Univ. of New York, Buffalo (USA). Lab. for Power and Environmental Studies). 30 Oct 1979. Contract AC03-79ET23044. 54p. NTIS, PC A04/MF A01. Order Number DE81026301.

A computer model has been established to predict MIS solar cell performance as a function of semiconductor and solar cell design parameters. The solar cell fabrication procedure was modified to more carefully examine the effect of the oxide growth temperature, resulting in a revised process producing cells with an increased average efficiency. I-V data for unpolished poly-Si MIS solar cells show space charge limited conduction indicative of a Gaussian trap distribution. Polished poly-Si gave a tunneling mechanism at low temperatures and tunneling via interface states at higher temperatures. Electron beam deposition of thin Si films on Al coated stainless steel was resumed and surface studies are reported. Radiation effect studies on MIS solar cells revealed an increased interface state density for proton and electron-irradianced solar cells. Auger studies on an oxide-covered Si surface and on a Cr-Cu-Cr-oxide-Si cell are reported. (LEW)

30139 (DOE/ET/23046—T2) Electrodeposition of polycrystalline and amorphous silicon for photovoltaic applications. Final report, June 11, 1979-September 10, 1980. Rauh, R.D. (EIC Labs., Inc., Newton, MA (USA)). Jun 1981. Contract AC03-79ET23046. 101p. NTIS, PC A06/MF A01. Order Number DE81027290.

Silicon was electrodeposited on metal substrates using two markedly different conditions. Polycrystalline deposits were obtained from K_2SiF_6 dissolved in high temperature (> 700°C) molten fluoride salts. The deposits produced at temperatures below 80°C from organo- and halo-silanes as silicon precursors in propylene carbonate electrolytes had an amorphous structure. Because the technology of electroplating silicon is largely undeveloped, a major emphasis was given to the electrochemical characterization of the plating baths and the relationship between the deposition conditions and the resulting deposits. The results with FLINAK [LiF (46.5%), KF (42.0%) and NaF (11.5%)] and the binary mixture LiF (50%) : KF (50%) as the molten salts for Si deposition were comparable. Cyclic voltammetry (CV) using a three-electrode configuration was done on the melts before and after addition of the silicon precursor. The amorphous silicon was deposited from propylene carbonate which had been dried over alumina. The best supporting electrolytes were tetrabutylammonium perchlorate and tetrafluoroborate. The silicon precursors investigated were $SiHCl_3$, $SiHBr_3$, $SiCl_4$, $(ClC_3H_6)SiCl_3$, $Si(OEt)_4$ and $(CH_3)_3SiCl$. Information on the chemical composition of the films was obtained from IR and Auger spectroscopy.

30140 (DOE/ET/23133—T2) Harvesting of close-spaced short-rotation woody biomass. Cullen, D.E.; Barr, W.J. (Mathtech, Inc., Princeton, NJ (USA)). 15 Jun 1980. Contract AC01-78ET23133. 101p. NTIS, PC A06/MF A01. Order Number DE81027314.

The objective of this project is to investigate alternative strategies and techniques of harvesting which appear to be commercially viable for use on closely spaced short-rotation biomass farms where coppicing will be used. Efforts to date have been concerned with identifying the characteristics of prospective woody biomass farms. Appendix I contains a summary of requirements for harvested wood used as feedstock for various conversion processes. The characteristics of harvesting, collecting, transporting, and storing equipment as used by the forest products and agricultural industries are described in this report. The applicability of the foregoing equipment to close-spaced, short-rotation biomass farms is discussed. The harvesting operation associated with supplying a single large wood conversion plant has been modelled to acheive the lowest cost system. (DMC)

30141 (DOE/ET/23197—T3) Semicrystalline casting process development and verification. Quarterly progress report number 3, December 19, 1980-March 19, 1981. (Semix, Inc., Gaithersburg, MD (USA)). 1981. Contract FC01-80ET23197. 61p. NTIS, PC A04/MF A01. Order Number DE81028206.

Experimentation with crystallization conditions and system materials in the Prototype 2 Ubiquitous Crystallization Process (UCP) system will increase our confidence in the system's ability to produce bricks of a consistent quality as well as serve to reduce costs of direct materials. The quality of semicrystalline material from prototype systems is being confirmed. Solar cells started with Prototype 1 and 2 material and processed in standard cell processing lines have compared favorably to material produced from the 4.2 kg equipment. In addition, design of a Prototype 3 UCP system was initiated this quarter. It will have the ability to crystallize nearly three times the silicon as the P1 and P2 systems. Investigation of the origins of subgrain boundaries of semicrystaline material continued. Other work may lead to an early in-line diagnostic tool of photoresponse patterns, by using chemical etchants and etch figures to determine dislocation densities. Two micro-computer based systems purchased this quarter will serve as the initial hardware in the further automation of the crystallization process and in a data collection and reporting system for early quality control. Experimentation continued on the ID and multiblade slurry technologies. Semix is working to optimize wafering parameters to increase throughput and yields.

30142 (DOE/JPL/955699—81/04) Process development for automated solar cell and module production. Task 4. Automated array assembly. Quarterly report No. 4. Hagerty, J.J. (Tracor MBA, San Ramon, CA (USA)). 15 Jul 1981. Contract NAS-7-100-955699. 41p. NTIS, PC A03/MF A01. Order Number DE81028438.

The Unimate robot was programmed for the final 35-cell pattern to be used in the fabrication of the deliverable modules. Mechanical construction of the Automated Lamination Station and Final Assembly Station were completed on schedule. All final wiring and interconnect cables have also been completed and the first operational testing is underway. The final controlling program has been written and is currently being optimized. A local fabricator has been contracted to produce the Glass Reinforced Concrete (GRC) panels to be used for testing and deliverables. A video tape showing all three stations in operation has been produced for display at the 18th PIM.

30143 (DOE/NASA/20485—9) Comparison of photovoltaic cell temperatures in modules operating with exposed and enclosed back surfaces. Namkoong, D.; Simon, F.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1981. Contract AI01-76ET20485. 22p. (NASA-TM—81769). NTIS, PC A02/MF A01. Order Number DE81026537.

Four different photovoltaic module designs were tested at the NASA Lewis Research Center to determine the cell temperature of each design. The cell temperatures were compared to those obtained on identical designs at the Jet Propulsion Laboratory (JPL) using the same procedure as propounded by JPL, and known as the nominal operating cell temperature (NOCT) concept. The results indicated an agreement between the two locations of within 2-1/2°C for each of the four module designs. In addition, the modules at NASA-Lewis were tested with the back surface enclosed (as may apply when installed on a roof), with and without insulation. These results showed that the NOCT procedure would not apply to the enclosed configurations due to continuous transient conditions. Generally, the enclosed modules had higher cell temperatures than the open modules, and insulated modules higher than the uninsulated. The severest performance loss - when translated from cell temperatures - was 17.5 percent for one enclosed, insulated module as compared to that module mounted openly.

30144 (DOE/SF/01284—T3) Gallium arsenide thin films on tungsten/graphite substrates: Phase II. Topical report: thin film gallium arsenide solar cells on tungsten/graphite substrates. Chu, S.S. (Southern Methodist Univ., Dallas, TX (USA)). Dec 1977. Contract AC03-76SF01284. 11p. NTIS, PC A02/MF A01. Order Number DE81027717.

The use of a thin film of gallium arsenide on a low cost substrate appears to be a promising approach for the fabrication of low-cost high-efficiency solar cells. Gallium arsenide films have been deposited on tungsten/graphite substrates at 775°C by the reaction of gallium, hydrogen chloride, and arsine in a gas flow

system. The deposited films are essentially polycrystalline with an average crystallite size of about 10 μm. Without intentional doping, the deposited films are n-type with carrier concentrations in the range of 2 x 10^{16} to 8 x 10^{16} cm^{-3} at room temperature. N-type gallium arsenide films of higher dopant concentrations can be readily deposited by using hydrogen sulfide as a dopant. The MOS approach has been used for the preparation of solar cells. After the successive deposition of n^+ - and n-gallium arsenide films on a tungsten/graphite substrate, the surface of the film was oxidized in situ with an argon-oxygen mixture and in some cases, followed by a water vapor treatment at room temperature. The gold barrier and silver grid contacts were applied by evaporation. An antireflection coating of titanium dioxide was deposited at 80 to 100°C by the hydrolysis of tetraisopropyl titanate in an argon atmosphere. A number of large area (6 to 9 cm^2) solar cells have been prepared, and the best cells have an AM1 efficiency of about 5.5%.

30145 **(DOE/SF/01284—T4) Thin films of gallium arsenide on low-cost substrates. Annual report, September 1, 1976-August 31, 1977.** Chu, S.S. (Southern Methodist Univ., Dallas, TX (USA)). Sep 1977. Contract AC03-76SF01284. 70p. NTIS, PC A04/MF A01.

Efforts during this year have been directed to (1) the construction of two gallium arsenide deposition systems using the halide process, (2) the preparation of tungsten/graphite and germanium(recrystallized)/tungsten/graphite substrates, (3) the deposition and characterization of gallium arsenide on tungsten/graphite substrates, and the fabrication and characterization of thin film gallium arsenide solar cells, and (4) the deposition and characterization of gallium arsenide films on germanium (recrystallized)/tungsten/graphite substrates and the fabrication of solar cells. Gallium arsenide films have been deposited on W/graphite substrates under a wide range of substrate temperature and reactant composition, and their properties have been evaluated. Films deposited under optimum conditions have an average crystallite size of about 15 μm and are essentially polycrystalline. Schottky barriers on these films do not exhibit ideal behaviors. MOS type solar cells with an AM1 efficiency (no AR coatings) of up to 3.5% have been produced. Gallium arsenide films deposited on Ge(recrystallized)/W/graphite substrates have considerably larger crystallites with a strong (111) preferred orientation and contains a high concentration of germanium, about 10^{17} cm^{-3}. Solar cells from these films have poor characteristics due to the high diffusion rate of germanium along grain boundaries.

30146 **(EXXON/GRU—2BEC.76) Heterostructure single-crystal-silicon photovoltaic cell. Quarterly report No. 1, January 1-March 31, 1977.** Ghosh, A.K.; Feng, T.; Fishman, C.; Merrin, S.; Grater, I. (Exxon Research and Engineering Co., Linden, NJ (USA); Emdex Corp., Milford, CT (USA)). 1977. Contract AC03-76ET20407. 37p. NTIS, PC A03/MF A01. Order Number DE81024295.

SnO_2/Si solar cells previously fabricated by Innotech are analyzed, and some device parameters are listed. Some conclusions are drawn concerning the cells' principle of operation. SIMS and Auger analysis of the cells are reported. The fabrication of SnO_2/Si solar cells is described and the effects of each processing step on device performance are discussed. Some Kelvin probe and photoemission studies are reported underway to find the work function of SnO_2 from which its electron affinity may be determined, thus explaining why a n^+/n silicon junction is more efficient than n^+/p. The steps in manufacturing are enumerated to facilitate cost studies. (LEW)

30147 **(PB—81-800401) Silicon solar cells. November 1978-October 1979 (citations from the Engineering Index Data Base). Report for November 1978-October 1979.** Reimherr, G. (National Technical Information Service, Springfield, VA (USA)). Nov 1980. 177p. NTIS PC N01/MF N01.

Worldwide research on the development of solar energy conversion devices using silicon ribbons, sheets, films, crystals, and wafers is cited. The preparation, purity, crystal defects, and efficiency of these cells are covered. The economics of solar cell development is discussed. The effects of radiation and weathering on performance are included. (Contains 171 citations.)

30148 **(PB—81-800419) Silicon solar cells. November 1979-October 1980 (citations from the Engineering Index Data Base). Report for November 1979-October 1980.** Reimherr, G. (National Technical Information Service, Springfield, VA (USA)). Nov 1980. 169p. NTIS PC N01/MF N01.

Worldwide research on the development of solar energy conversion devices using silicon ribbons, sheets, films, crystals, and wafers is cited. The preparation, purity, crystal defects, and efficiency of these cells are covered. The economics of solar cell development is discussed. The effects of radiation and weathering on performance are included. (This updated bibliography contains 162 citations, all of which are new entries to the previous edition.)

30149 **(PB—81-800435) Silicon solar cells. November 1979-October 1980 (citations from the NTIS Data Base). Report for November 1979-October 1980.** Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Nov 1980. 166p. NTIS PC N01/MF N01.

Citations of Government-sponsored research reports on silicon solar cell growth and fabrication are presented. Processes covered include chemical vapor deposition, the Czochralski method, dendritic growth, ribbon growth, epitaxial growth, and silicon sheet fabrication on substrates. Silicon compound synthesis, purification, and reduction are discussed. Casting, cutting, and shaping of silicon solar cells are included. Solar energy conversion efficiency and performance are described. Abstracts on costs and production of these cells are covered. (This updated bibliography contains 159 citations, all of which are new entries to the previous edition.)

30150 **(PB—81-800443) Silicon solar cells. December 1977-October 1979 (citations from the NTIS data base). Report for December 1977-October 1979.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Nov 1980. 291p. NTIS PC N01/MF N01.

Citations of Government-sponsored research reports on silicon solar cell growth and fabrication are presented. Processes covered include chemical vapor deposition, the Czochralski method, dendritic growth, ribbon growth, epitaxial growth, and silicon sheet fabrication on substrates. Silicon compound snthesis, purification, and reduction are discussed. Casting, cutting, and shaping of silicon solar cells are included. Solar energy conversion efficiency and performance are described. Abstracts on costs and production of these cells are covered. (This updated bibliography contains 284 citations, 75 of which are new entries to the previous edition.)

30151 **(SERI/PR—9330-1-T2) Preparation and properties of evaporated CdTe films compared with single crystal CdTe. Progress report No. 2, February 1-April 30, 1981.** Bube, R.H. (Solar Energy Research Inst., Golden, CO (USA); Stanford Univ., CA (USA). Dept. of Materials Science and Engineering). 1981. Contract AC02-77CH00178. 29p. NTIS, PC A03/MF A01. Order Number DE81023079.

The design, construction and testing of the hot-wall vacuum evaporation system is proceeding on schedule. The vacuum system, a Varian 3118 diffusion pump system, has been installed and tested. A calculation of the optimum possible efficiency for an n-p CdTe homojunction indicates a value of 14%. A complete background is given on the growth of over fifty CdTe single crystals at Stanford, the last four of which were grown as part of this program. Use of crystal regrowth and vibration during growth both increase crystal quality. Higher electrical activity of phosphorus acceptors in CdTe is achieved when 0.1% excess Te is used in place of 0.5% excess Te. Careful characterization of boules grown for this program are underway, using Hall effect or capacitance-voltage data on selected samples. Initial investigation of the properties of grain boundaries in p-type CdTe : P crystals indicates a grain boundary height of 0.44 eV unaffected by illumination. These results suggest that grain boundaries are more strongly pinned in p-type than in n-type CdTe.

30152 **(SERI/SP—751-902) Alcohol fuels bibliography, 1901-March 1980.** (Solar Energy Research Inst., Golden, CO (USA)). Apr 1981. Contract AC02-77CH00178. 468p. NTIS, PC A20/MF A01. Order Number DE81025482.

This annotated bibliography is subdivided by subjects, as follows: general; feedstocks-general; feedstocks-sugar; feedstocks-

starch; feedstocks-cellulose crops and residues; production; coproducts; economics; use as vehicle fuel; government policies; and environmental effects and safety. (MHR)

30153 **(SERI/TR—734-900) Costs for alternative grain-residue-collection systems.** Flaim, S.J.; Neenan, B.; Dauve, J.; Mapp, H.P. Jr. (Solar Energy Research Inst., Golden, CO (USA); Oklahoma State Univ., Stillwater (USA). Dept. of Agricultural Economics). Jun 1981. Contract AC02-77CH00178. 55p. NTIS, PC A04/MF A01. Order Number DE81029072.

The costs for alternative grain residue collection systems for corn and soybean production in Iowa are examined. All machinery field operations, fuel, other inputs, and labor requirements are identified for the base case with no residue harvest, and for residue harvest by stacks and large round bales, with the owner's equipment and for custom harvest. These five cases are developed for corn and soybeans for conventional and reduced tillage practices. Harvesting alternatives are compared on the basis of costs, fuel input requirements, and gross energy balances of residues collected less energy inputs. The cost of collecting corn and soybean residues varies widely over the collection and tillage systems examined. Other effects constant, the reduced tillage practice leads to a lower cost of harvest than conventional tillage, and stacks are always cheaper than large round bales; however, the former difference is greater than the latter. The dominating effect, in terms of cost of production, is the tillage employed by the producer. Collection of residues yields an energy equivalent 26 times the amount of energy consumed for conventional tillage and 135 times the amount of energy consumed for reduced tillage practices.

30154 **Sun concentration system for photoelectric energy conversion. Final report.** Kleinwaechter, H. Luxembourg; Commission of the European Communities (1980). 48p. (In German). (EUR—6953-DE). European Community Information Service, Washington, DC.

A theoretical and applied study was made of the construction and installation of various concentrator solar cell systems for use both in the European Community and in developing countries. Model plants were erected and the efficiency, directional characteristics, precision, and dispersion behavior of the systems were investigated. The concentrator system and follow-up devices were shown to require no special maintenance and were found to function under extreme environmental conditions. Two prototype concentrator solar cell plants and experimental runs are planned that will employ a five-component concentrator to be used as a pneumatic concentrator. The pneumatic type concentrator was found to make it possible to vary the concentration factor from one to several hundred by changing the pressure. Experiments are planned to test the life-time of the concentrators and the solar cells, to optimize the concentration factor, to establish the maintenance and servicing expenses, and the systems' behavior under unfavorable climatic conditions. The operation of a combined concentrator and solar cell system with photovoltaic and thermal utilization is viewed as a valuable concept for a wide range of applications.

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REFER ALSO TO CITATION(S) 30129, 30901

30155 **(DOE/ET/20279—T8) Description of battery state-of-charge controller.** Cadieux, R.N. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). May 1981. Contract AC02-76ET20279. 11p. (COO—4094-82). NTIS, PC A02/MF A01. Order Number DE81026294.

A battery state-of-charge controller has been designed to meet the requirements of the off-peak, stand-alone solar photovoltaic power system now undergoing tests at MIT Lincoln Laboratory's Photovoltaic Systems Test Facility in Concord, Massachusetts. Design requirements, physical description, circuit description, theory of operation and operation procedures are presented.

30156 **(SAND—80-7014/1) Conceptual design and system-analysis study for a hybrid solar-photovoltaic/solar-thermal electric-power system. Volume I of III. Final report, executive summary.** (Sandia National Labs., Albuquerque, NM (USA); Spectrolab, Inc., Sylmar, CA (USA)). Jul 1981. Contract AC04-76DP00789. 59p. NTIS, PC A04/MF A01. Order Number DE81026162.

A description of an analysis of hybrid photovoltaic/solar thermal electric conversion systems is summarized. Several types of hybrid systems, photovoltaic-only systems, and solar thermal electric systems were compared in terms of performance and cost. Generally, hybrid systems are shown to be potentially competitive with photovoltaic-only or solar thermal electric conversion systems, but hybrid systems do not appear to have a significant advantage, on a levelized cost per kilowatt-hour basis.

30157 **(SAND—80-7014/2) Conceptual design and system analysis study for a hybrid solar photovoltaic/solar thermal electric power system. Volume II of III. Study results. Final report.** (Sandia National Labs., Albuquerque, NM (USA); Spectrolab, Inc., Sylmar, CA (USA)). Jul 1981. Contract AC04-76DP00789. 242p. NTIS, PC A11/MF A01. Order Number DE81026737.

An analysis of hybrid photovoltaic/solar thermal electric conversion systems is described in detail. Several types of hybrid systems, photovoltaic-only systems, and solar thermal electric systems were compared in terms of performance and cost. Generally, hybrid systems are shown to be potentially competitive with photovoltaic-only or solar thermal electric conversion systems, but hybrid systems do not appear to have a significant advantage, on a levelized cost per kilowatt-hour basis.

30158 **(SAND—81-7003) Design and conditioning of a 50-kVA power-conditioning unit for photovoltaic power systems. Final report.** Stechschulte, D.L.; Shuey, K.C.; Vonderembse, J.F.; Shireman, D.W.; Niederjohn, W.M. (Sandia National Labs., Albuquerque, NM (USA); Westinghouse Electric Corp., Lima, OH (USA). Aerospace Electrical Div.). Jul 1981. Contract AC04-76DP00789. 219p. NTIS, PC A10/MF A01. Order Number DE81029112.

A 50-kVA power conditioning unit is described including its operation, mechanical layout, factory tests results, and recommendations for future work. The appendixes include a description of the microprocessor controller for the power system, applicable drawings, and a summary of the design specifications for the power conditioning unit.

30159 **(SAND—81-7085/1) Intermediate photovoltaic-system application experiment operational performance report. Volume 1 for Lovington Square Shopping Center Site, Lovington, NM.** (Sandia National Labs., Albuquerque, NM (USA); Boeing Computer Services Co., Seattle, WA (USA)). Jul 1981. Contract AC04-76DP00789. 18p. NTIS, PC A02/MF A01. Order Number DE81028971.

A 100 kWp photovoltaic flat panel system is planned for application in a shopping center to assess problems associated with utility tie-in and to provide utility experience with a photovoltaic system. The project is briefly outlined, and the participants are listed. Relevant weather data and reference operating conditions are given and four operational modes are described. System specifications are given and the solar array, control, protection, and data acquisition and instrumentation subsystems are described. (LEW)

30160 **(SAND—81-7086/1) Intermediate photovoltaic-system application: experiment operational performance report. Volume 1 for Newman Power Station Site, El Paso, TX.** (Sandia National Labs., Albuquerque, NM (USA); Boeing Computer Services Co., Seattle, WA (USA)). Jul 1981. Contract AC04-76DP00789. 16p. NTIS, PC A02/MF A01. Order Number DE81029283.

A project is described for application of a photovoltaic power supply to computers that control the operation of a combined cycle power plant. The photovoltaic power supply will be used with an existing DC facility. The project is briefly outlined, and the participants are listed. Relevant weather data and reference operating conditions are given and four operational and collection

modes are described. System specifications are given and the solar array, protection, and data acquisition and instrumentation subsystems are described. (LEW)

30161 (SAND—81-7088/1) Intermediate photovoltaic-system application experiment operational performance report. Volume 1. (Sandia National Labs., Albuquerque, NM (USA); Boeing Computer Services Co., Seattle, WA (USA)). Jul 1981. Contract AC04-76DP00789. 16p. NTIS, PC A02/MF A01.

A program for providing a high school with a 100 kW solar photovoltaic flat panel power system and for obtaining experience with it is outlined, including a list of participants, operating, insolation, and weather data, definition of operational and data collection modes, system specifications and subsystem descriptions. (LEW)

30162 (SAND—81-7090/1) Intermediate photovoltaic-system application experiment operational performance report. Volume 1. For Mt. Laguna Radar Station Site, Mt. Laguna, CA. (Sandia National Labs., Albuquerque, NM (USA); Boeing Computer Services Co., Seattle, WA (USA)). Jul 1981. Contract AC04-76DP000789. 18p. NTIS, PC A02/MF A01. Order Number DE81028189.

A program for constructing a remote military photovoltaic power network and for demonstrating that a dc-ac photovoltaic energy conversion system, without on site energy storage, can effectively augment a diesel-powered electric grid, is outlined. Included are a list of participants, insolation and operating data, definitions of operational and data collection modes, system specifications and subsystem descriptions. (LEW)

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 30125, 30156, 30157, 30231, 30261, 30263, 30266, 30268, 30270, 30491, 30492, 30493, 30660, 30947, 30948

30163 (ATR—76(7523-13)-1) Solar-total-energy-systems test-facility requirements. (Aerospace Corp., El Segundo, CA (USA). Energy and Transportation Div.). Dec 1975. Contract AT03-76CS51101. 78p. NTIS, PC A04/MF A01. Order Number DE81026554.

The near term test requirements are addressed and supporting rationale provided. Pertinent features and system performance of the solar total energy installation are examined. The performance capabilities of the Sandia Facility are briefly summarized and compared on a functional subsystem basis with the test requirements. (LEW)

30164 (DOE/CS/30278—T13) Solar Technology Assessment Project. Volume IX. Heliostat systems: technical and economic assessment. Hildebrandt, A.F.; Laurence, C.L. (Florida Solar Energy Center, Cape Canaveral (USA); Houston Univ., TX (USA). Energy Lab.). Apr 1981. Contract FC02-79CS30278. 92p. NTIS, PC A05/MF A01. Order Number DE81029010.

An extensive review of the literature is provided on heliostat central receiver systems including subsystem design and research experiments, full scale system designs, assessments, evaluations, rankings, application and marketing studies, and heliostat manufacturing studies. The current status of heliostat system development is reviewed and assessed. Recent design reports are examined, and expected economic and performance improvements are reported. Recommendations are made for the role that government can play in heliostat systems development, and for state and federal policies for development of solar commercialization and the formation of heating utilities. (LEW)

30165 (DOE/CS/51101—T1) ERDA solar-thermal projects semiannual review: dispersed power systems, distributed collector, and research and development. (Aerospace Corp., Los Angeles, CA (USA). Energy and Transportation Div.). Jan 1977. Contract AT03-76CS51101. 141p. NTIS, PC A07/MF A01. Order Number DE81024291.

Twenty-five projects are summarized, highlights of each are given and any available update information on each is presented. These include technical support activites, project management, mission analyses and application studies, progress with various collector, concentrator and coating systems, and research projects and test facilities. (LEW)

30166 (DOE/ET/20168—T6) Solar-receiver heat-flux and structural studies. Second quarterly progress report, October, November, December 1975. Robin, R.D. (Rocketdyne, Canoga Park, CA (USA)). 1975. Contract AC03-76ET20168. 29p. (ASR—76-2). NTIS, PC A03/MF A01.

Effort was directed toward facility heater calibration and instrumentation evaluation utilizing a specially fabricated 5 foot long test tube with various types of thermocouples attached. Thermal analysis of the thermocouple attachment was also undertaken to estimate measurement error resulting from radiant heat input. A maximum heat flux level of slightly greater than 1.0 Btu/in.^{2}-sec was achieved in the subscale calibration tests. The thermocouple measurement error at this operating condition was determined to be about 90°F for the silver braze attachment technique. Tip-welded thermocouples resulted in measurement errors of several hundred degrees (F) due to the high radiant heat flux level. The computerized data acquisition system was checked out and performed satisfactorily. Additional heater/reflector optimization was conducted in terms of matching test requirements with the power system operating limits. The graphite heater arrays are currently being installed. The 65 foot long, 3/8 in. O.D. single tube test section was instrumented with 33 chromel-alumel thermocouples using a silver braze attachment technique. This test section has been installed in the facility with appropriate backup structure to permit free longitudinal thermal expansion.

30167 (DOE/ET/20195—T3) Advanced thermal-energy-storage-concept definition study for solar Brayton power plants. Thermochemical TES sizing computer program. Volume III. Progress report, July 1-December 31, 1976. (Boeing Engineering and Construction Co., Seattle, WA (USA)). 1976. Contract AC03-76ET20195. 104p. NTIS, PC A06/MF A01. Order Number DE81026130.

Portions of document are illegible.

The computer program CESTOR used to size and evaluate the SO_2/SO_3 thermochemical energy storage device for application with the high temperature gas cooled solar power plant is described. A description of the program and how it is used including inputs, outputs, and operating instructions is given. (WHK)

30168 (DOE/ET/20417—T4) MDAC heliostat field array wind tunnel test data summmary report. Xerikos, J.; Tang, H.H. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Mar 1978. Contract AC03-76ET20417. 45p. NTIS, PC A03/MF A01.

A wind tunnel test of the MDAC heliostat configuration in a single heliostat, clustered heliostats and clustered heliostats with fence was performed. The tests were conducted at the Fluid Dynamics and Diffusion Laboratory of Colorado State University during February and March 1978. The purpose of the test was to experimentally evaluate the aerodynamic loadings associated with the air flow patterns within and over clusters of heliostats selected from both perimeter and interior locations of the field array. The heliostat model was scaled by a factor of 1:22, and cluster configurations ranged from 7 to 12 heliostats. The test was successful and data taken appears consistent in terms of peak load with previous data obtained by MDAC in the Douglas Aircraft Low Speed Tunnel. For single heliostat pitching moments peak at 30° elevation angle. For clustered heliostats this value is usually lower with no distinct peak evident. Effects of having an open, half-closed, or fully-closed heliostat center slot appear to be small. Pressure distributions on heliostat surfaces (front and back) are relatively non-uniform, both on planar surfaces and the support post. A wind fence with 33% porosity provides significant reduction in the aerodynamic loads with pitching moments and drag forces reduced 50% to one order of magnitude.

30169 (DOE/ET/20424—T9) Central-receiver solar-thermal power system. Collector subsystem quarterly technical progress report. (Boeing Engineering and Construction Co., Seattle, WA (USA)). 31 Dec 1975. 89p. (D—277-10014-1). NTIS, PC A05/MF A01. Order Number DE81026298.

The preliminary design baseline collector subsystem for a 10 MW/sub e/ solar thermal Pilot Plant is described. Design studies aimed at establishing th heliostat field geometry, and the detailed configuration of the protective enclosure assembly, reflective assembly, and drive and control assembly are reported. Results of thermal design analyses are provided. The testing to be implemented during development, assembly, integration and array testing of the collector subsystem research experiment hardware is described, and the test objectives and testing sequence are given. These include component and material test, assembly and integration tests, and array tests. Results of completed tests are given. (LEW)

30170 (DOE/ET/20424—T13) Collector-subsystem preliminary design baseline report. (Boeing Engineering and Construction Co., Seattle, WA (USA)). 24 Nov 1975. Contract AC03-76ET10424. 142p. NTIS, PC A07/MF A01. Order Number DE81024344.

The preliminary design baseline collector subsystem for the 10 MWe solar thermal pilot plant is described along with all supporting data and analyses used in selecting the specific design. The performance requirements, interface requirements, heliostat field performance analyses, design studies on the three collector subsystem subassemblies (reflector, enclosure, and drive and control), and thermal design are discussed. Plans for installation and maintenance are presented. Necessary electrical and mechanical support equipment are listed, and safety considerations are summarized. (LEW)

30171 (DOE/ET/20567—1Vol.1) Conceptual design of solar central-receiver hybrid power system: sodium-cooled-receiver concept. Volume I of II. Conceptual design. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 1979. Contract AC03-78ET20567. 421p. (ESG—79-3Vol.1). NTIS, PC A18/MF A01.

A market analysis is reported consisting of estimates of overall market size derived from projections of electric power growth, examination of utility plans, and projections of potential regulatory action. Market share is projected by comparisons of the levelized costs of busbar power produced by hybrid coal solar units with costs of other electric power producers such as coal only, nuclear and solar only units. Parametric analyses of the major subsystems, consisting of the collector, receiver, storage, non-solar, electric power generation, and master control subsystems were conducted over a wide range of independent parameters in order to define subsystem operation and interfaces for use in the preferred system selection studies. The selection of the system, subsystems, and components of the 0.8 and 1.4 solar multiple sodium-cooled hybrid central receiver configurations were done. Technically feasible alternatives were compared on an economic basis. Detailed conceptual designs of the selected system concepts for the 0.8 and 1.4 solar multiple plants are presented. Cost estimates are also presented for both plants based on the conceptual designs. (LEW)

30172 (DOE/ET/20567—T6) Conceptual design of solar central-receiver hybrid power system: sodium-cooled-receiver concept. Volume II. Appendices. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 1979. Contract AC03-78ET20567. 311p. NTIS, PC A14/MF A01. Order Number DE81026966.

A trade study to select a fossil fuel and receiver size for the 100 MWe conceptual design of the Solar Central Receiver Hybrid Power System is presented. Parallel and series configurations for the solar receiver and fossil-fired sodium heater are compared. A steam cycle optimization study is presented. Data for a tower analysis and receiver mass distribution study are given, and design data sheets are included for solar multiples of 0.8 and 1.4. P and I diagrams of the electric power generation subsystem and of the 0.8 and 1.4 solar multiple solar power system are included. The system response to the loss of a pump and to the loss of sunlight is analyzed. (LEW)

30173 (DOE/SF/10597—T1) Analysis of the technical and economic feasibility of solar feedwater heating for El Paso Electric Company. (El Paso Electric Co., TX (USA); Stone and Webster Engineering Corp., Boston, MA (USA)). Feb 1980. Contract AC03-79SF10597. 92p. NTIS, PC A05/MF A01. Order Number DE81024213.

A solar feedwater heating system consisting of a linear focusing solar collector subsystem, a thermal energy transport subsystem, and possibly a thermal energy storage subsystem is studied for integration with an existing steam power cycle system. The solar heating system is described. The proposed system concept is compared to several previously published studies. An economic evaluation of the costs and benefits of modifying the existing unit to employ solar feedwater heating was performed. The levelized value of the fuel oil savings were determined by a computer program over the remaining economic life of the unit, based on solar insolation data for El Paso and relevant economic factors for four cases. The conceptual design refinements and documented cost breakdown are given. (LEW)

30174 (DOE/SF/10601—0) Economic assessment of advanced central-receiver solar-thermal power systems. Executive summary. (Westinghouse Electric Corp., East Pittsburgh, PA (USA). Advanced Systems Technology Div.). Oct 1980. Contract AC03-79SF10601. 23p. NTIS, PC A02/MF A01.

The value and potential electric utility impact of several advanced central receiver solar-thermal plant concepts in the role of electric generating stations are estimated. The impacts of interest included economics, the cost of producing electricity, fuels displaced, and utility system reliability. The central receiver plants evaluated included solar/fossil hybrid concepts and solar standalone plants with thermal storage. Liquid metal/molten salt, closed Brayton cycle, improved water-steam, and combined Brayton/Rankine cycle concepts were among those investigated. Detailed modeling of the operation of these plants, as they would operate on several electric utility systems, was the primary analytical method used. Because of the uncertainy of many assumptions, sensitivity analysis was used extensively. Analysis to optimize collector area and storage capacity was also performed. The study indicates that if the DOE cost goals can be achieved and projected solar plant performance attained, then the advanced solar-thermal concepts can be competitive in regions with good insolation and some continued use of oil or other surrogate distillate or gaseous fuels. Some thermal storage (3 to 6 hours) was also found to be desirable for most applications.

30175 (DOE/SF/10738—T2) Repowering for electric generation Northeastern Station Unit 1, Public Service Company of Oklahoma. (Black and Veatch, Kansas City, MO (USA)). 10 Mar 1980. Contract AC03-79SF10738. 28p. NTIS, PC A03/MF A01. Order Number DE81022290.

Work is reported toward solar repowering of an existing 150 MWe gas and oil fired steam electric generating unit. The solar portion is a 33 MWe central receiver steam generation system. System analyses relating to plantwide aspects of repowering the unit were conducted. Collector fields have been designed which maximize annual energy for alternate receiver and steam condition considerations. Receiver system studies are performed to select the configuration from along the alternatives: cavity or external receiver; fossil or solar energy to heat the reheat steam; steam pressure and temperature conditions at the receiver outlet; and flux distribution. The status of the conceptual design task is given, particularly in the control system, and the progress of program plan and management activities is outlined. (LEW)

30176 (DOE/SF/10802—T1) Economic analysis of the unified heliostat array. (Veda, Inc., Camarillo, CA (USA); Bechtel National, Inc., San Francisco, CA (USA)). 13 Jun 1980. Contract AC03-80SF10802. 77p. NTIS, PC A05/MF A01.

Viewgraphs for the mid-term review outline the contract objectives and project details, give optical performance assumptions and constraints, and diagram the methodologies for the performance determination. The method of calculating performance is outlined. The flux distribution over the heliostat field is computed and graphed. (LEW)

30177 (DOE/SF/90506—T1) Solar 1/4-MWth receiver test plans. (Sanders Associates, Inc., Nashua, NH (USA). Defensive Systems Div.). 21 Dec 1977. Contract AC03-77SF90506. 94p. NTIS, PC A05/MF A01.

The program to measure the performance of a 1/4 MWth model of the receiver at the solar test facility at the Georgia Institute of Technology is described, and the plan for preliminary testing prior to shipping to GIT is presented. The platform, receiver, hot air and cold air assemblies, and control panel are described. The instrumentation needed to measure the thermal efficiency of the receiver is listed. Operational procedures are given. Support facilities and personnel are briefly discussed, and a tentative schedule of test runs is given. Safety considerations are outlined. A set of viewgraphs provide supporting material. (LEW)

30178 (SAND—80-8049) **Department of Energy solar central receiver semiannual meeting.** (Sandia National Labs., Albuquerque, NM (USA)). Jan 1981. Contract AC04-76DP00789. 273p. (CONF-8010129—). NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

Separate abstracts were prepared for 30 papers in these proceedings. One additional paper entitled "Assessment of Solar Options for Large Power Applications" was previously abstracted for EDB. (LEW)

30179 (SAND—80-8049, pp 9-15) **Overview of the solar thermal program.** Braun, G. (Dept. of Energy, Washington, DC). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The goals and current status of the solar thermal program is reviewed. The organization of the program is discussed briefly, as is funding for fiscal year 1981. Technical progress and future prospects are discussed. (LEW)

30180 (SAND—80-8049, pp 16-18) **Central receiver program summary.** Hughey, R.W. (Dept. of Energy/SAN, Oakland, CA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The Repowering Program's current status and future prospects are summarized. Based upon encouraging results of studies of repowering, a Program Opportunity Notice is being finalized to solicit proposals for the design and construction of repowering projects to be operational by 1985. High level support for the program and a commitment to use the Barstow Pilot Plant as a repowering test facility are reported. The market development of repowering and cogeneration is discussed. (LEW)

30181 (SAND—80-8049, pp 19-30) **Technical overview of the US central receiver program.** Skinrood, A.C. (Sandia National Labs., Livermore, CA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The status of the Central Receiver Test Facility, the Barstow Solar Pilot Plant, and the International Energy Agency 0.5-MWe plant in Almeria, Spain is given. Progress with electrical generation, process heat and cogeneration applications is discussed. Studies on receivers, heliostats, and energy storage are listed. (LEW)

30182 (SAND—80-8049, pp 31-50) **10 MWe solar thermal central receiver pilot plant.** Slaminski, J.M. (Dept. of Energy, El Monte, CA); Reeves, J.N. Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The Barstow Solar Pilot Plant project is described. Project costs are broken down for design and construction of the collector field, turbine generator, and the balance of the plant equipment, and government funding of the project is discussed. The project schedule is diagrammed. Progress with the production of heliostats, and problems with the mirror module are discussed. The status of receiver fabrication, thermal storage fabrication, and solar facilities construction is given. The final engineering and design of the Electric Power Generation Subsystem (EPGS) is completed, and the status of the EPGS equipment procurement activities are summarized. A layout of the final control room design is given. Civil/underground construction and control building construction are reported under way, and other construction work is described. (LEW)

30183 (SAND—80-8049, pp 51-64) **EURELIOS: the 1 MW(e) helioelectric power plant of the EC in Adrano, Sicily, Italy.** Gretz, J. (Joint Nuclear Research Center, Ispra, Italy). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The helioelectric power plant, EURELIOS, sponsored by the Commission of the European Communities is described. This plant, of the mirror-field and central receiver type, is being designed and built by a Consortium of European industries formed by ENEL and ANSALDO (Italy), CETHEL (France), and MESSERSCHMITT-BOLKOW-BLOHM (F.R. Germany). The plant will become operational towards the end of 1980 and will be connected to the grid of the Italian National Electricity Generating Board, ENEL, at Adrano, Sicily, Italy. ENEL will be the operator of the plant and co-proprietor along with the Commission of the European Communities.

30184 (SAND—80-8049, pp 65-72) **500 kW/sub e/ central receivers system (CRS) of the small solar power systems project (SSPS): Almeria.** Grasse, W. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt eV, Cologne, Germany). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The background, objectives, schedule and costs of the Small Solar Power System Project are briefly discussed. The central receiver system and its monitoring system are described. The current status and future plans for work on the central receiver system are discussed. (LEW)

30185 (SAND—80-8049, pp 73-82) **Results of utility value analysis.** Day, J.T. (Westinghouse Electric Corp., Pittsburgh, PA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The value of several advanced solar-thermal concepts was estimated through detailed modeling of their operation on utility systems. Parametric analysis was performed on major plant parameters such as collector area, storage capacity, penetration and location. Sensitivity analysis was also performed on the economic assumptions. The solar plant concepts studied included: a generic representation of the liquid metal and molten salt concepts with thermal storage, including solar/fossil hybrid plant designs and solar stand-alone (no fossil-fuel-burning capability); a closed Brayton-cycle system, solar stand-alone with thermal storage and solar/fossil hybrid without storage; an improved water/steam Rankine concept with thermal storage; a Brayton/Rankine combined-cycle solar/fossil hybrid concept without thermal storage. The EPRI regional synthetic utilities were used for this analysis as was SOLMET typical meteorological year data for selected sites.

30186 (SAND—80-8049, pp 95-102) **Comparative evaluation of 1 to 10 MWe solar thermal systems.** Thornton, J.P. (Solar Energy Research Inst., Golden, CO). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

Systems with capacity ranges of 1 to 10 MWe were examined for use in small utility applications. Capacity factors ranged from approximately 0125 (no-storage case) to as high as 0.7, consisting both electric and thermal storage. These systems were assumed to operate as an integral part of a grid. Smaller systems of 0.1 to 1 MWe capacity were considered for industrial, military, and small community use. These systems, which included storage capability, were designed as primary power sources, using the grid as backup. A set of representative economic factors were developed for use in both cases. (LEW)

30187 (SAND—80-8049, pp 103-106) **Central receiver solar cogeneration program overview.** Fisk, S. (Dept. of Energy, Oakland, CA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The objective for this program is to develop and commercialize solar cogeneration systems as a means of providing industry with additional options within the Solar Thermal Central Receiver program. Legislation in support of cogeneration is summarized, and seven proposals for conceptual design and economic studies for cogeneration facilities which were selected for negotiation are listed. (LEW)

30188 (SAND—80-8049, pp 107-110) **Commercialization of central receiver technology.** Prince, L.E. (Dept. of Energy, Oakland, CA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

Technology commercialization is defined and the plan for commercializing central receiver technology is outlined. The substance of the DOE program to achieve commercial status for solar thermal systems consists of market identification, innovative finance, incentives and study of barriers, market penetration, and regulation. (LEW)

30189 (SAND—80-8049, pp 111-114) **Commercialization of central receiver technology.** McCleary, R.E. (United States Gypsum Co., Chicago, IL). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The roles of the Barstow Pilot Plant Project and of the industrial inputs to process heat repowering relative to the development of central receiver technology are discussed. Some favorable financial incentives are briefly mentioned. Financing, risk, and competition for available funds are considered. The status of solar air heating, thermal storage, heliostat technology, and the interface between central hot air receiver systems and industrial operations is briefly stated. (LEW)

30190 (SAND—80-8049, pp 189-198) **Receiver development program overview.** Wilson, W.G. (Sandia National Labs., Livermore, CA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The receiver development program is diagrammed and a comparative evaluation of various 100 MWe on the basis of busbar energy costs versus capacity factor. Molten nitrate salt systems are shown to have a significant energy cost advantage for significant hours of storage, so the program emphasizes them. The status and technical achievements of the program are reviewed. (LEW)

30191 (SAND—80-8049, pp 199-206) **CRTF molten salt receiver subsystem research experiment (SRE).** Tracey, T.R. (Martin Marietta Corp., Denver, CO). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The receiver SRE is described, and the experiment parameters and instrumentation are summarized. Measurements of the convective loss from the receiver are reported. Testing accomplished through September 1980 and the status of the material test program are summarized. (LEW)

30192 (SAND—80-8049, pp 207-214) **Alternative central receiver power system program, Phase II.** Elsner, J.A.; Hussey, C.C. (General Electric Co., Schenectady, NY). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The objective of the Phase II program is the design, fabrication, installation, and testing of a 2.5 MWt sodium cooled test receiver. The Solar Receiver Test Assembly is described. The design and fabrication of the sodium loop and the absorber test panel are discussed, and the current program status is reported. (LEW)

30193 (SAND—80-8049, pp 225-234) **Cost-performance comparison of water-steam receiver for solar central electric power plants.** Schafer, C.T.; De Laquil, P.; Faas, S.E. (Sandia National Labs., Livermore, CA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The work of three receiver design teams, an electric power generation group, and a cost consultant contracted by Sandia is briefly described. The criteria for judging the water/steam receivers was the levelized cost of electricity in mills per kilowatt hour in 1979 dollars. The size selected for evaluation was 100 MWe with storage capacities ranging from 0 to 9 hours. The study was primarily concerned with the thermodynamic performance of systems that incorporated an improved receiver design. The procedure for optimizing the complete system is outlined. The computer program QDSTOR used for studying storage costs is described. (LEW)

30194 (SAND—80-8049, pp 235-242) **Experimental investigation of convective losses from solar receivers.** Clausing, A.M.; Kempka, S.N.; Skarda, J.R. (Univ. of Illinois, Urbana). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The program discussed utilizes a cryogenic wind tunnel which operates at test section gas temperatures ranging from 80k to 320k. The main objectives of the program are to establish the cryogenic heat transfer tunnel as a viable method of studying natural, forced, and combined convective heat transfer at large Reynolds and/or Grashof numbers, and to test models of solar receivers and obtain expressions for the prediction of the convective loss from the external, 10 MWe receiver under a multitude of operating conditions. Both pressure and heat transfer data are presented. A finite aspect ratio model was constructed and is described. Results for free convection and work on combined convection are discussed. (LEW)

30195 (SAND—80-8049, pp 243-254) **Convective losses from solar central receivers.** Moffat, R.J. (Stanford Univ., CA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

Efforts to develop a computer code and a supporting experimental data base which can be used to predict the convective losses from an external receiver are described. The program involves an experimental and an associated analytical study of mixed free and forced convection with the buoyant force orthogonal to the shear force. The technical design of the experiment and the present status of both the experimental and analytical studies are described, and future work is projected. (LEW)

30196 (SAND—80-8049, pp 255-262) **Investigation of free-forced convection flows in cavity-type receivers.** Humphrey, J.A.C.; Sherman, F.S. (Univ. of California, Berkeley). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

Work is outlined to develop, test and apply a numerical calculation procedure for predicting general flow and heat transfer characteristics in and about cavity receivers, and to provide experimental data against which the procedure may be validated by visualizing and measuring the flow and heat transfer characteristics of an electrically heated laboratory-scale cavity receiver model. While the study attention is focussed on 2-dimensional flow, extension to 3-dimensions is straightforward, although calculations are costly. Accomplishments for 1979 to 1980 and work projected for 1980 to 1981 are summarized. (LEW)

30197 (SAND—80-8049, pp 263-268) **Large cavity energy loss experiment.** Kraabel, J. (Sandia National Labs., Livermore, CA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

A study is performed of the convective and radiative losses from a cavity that simulates a cavity-type solar central receiver. There are two central goals for the experiment. The first is to do

flow visualization experiments and make flowfield measurements to provide information for modeling the problem. The second goal is to measure the energy losses, thereby verifying the predictive schemes. The emphasis is on realistic simulation rather than scale modeling; the interior surface temperatures are in the same range as for actual receivers and the size is large enough to be in the same flow regime. Preliminary indications are that the flow is turbulent and very complex on the upper surface. The side walls exhibit distinct boundary layer flow. (LEW)

30198 **(SAND—81-8178-Vol.1) Second-generation heliostat development. Volume I. Sections 1.0 to 3.0. Final report.** (Sandia National Labs., Albuquerque, NM (USA); Northrup, Inc., Hutchins, TX (USA); Bechtel National, Inc., San Francisco, CA (USA); Booz, Allen and Hamilton, Inc., Cleveland, OH (USA)). Mar 1981. Contract AC04-76DP00789. 203p. NTIS, PC A10/MF A01. Order Number DE81028870.

The Northrup heliostat, the major component elements, and the rationale for the approach selected are described in detail. The performance evaluation is presented, including weight, deflections, stress levels, and, in the case of the drive unit, torque, speed, and efficiency performance. System studies are summarized, including wind loads and moments, mirror module trade studies, rack structure trades, drive unit trade studies, and stow position trade studies. The results of the electronic and mechanical tests are summarized. Included in Vol. I is a brief summary of the whole 4-volume report. (LEW)

30199 **(SAND—81-8178-Vol.2) Second-generation heliostat development. Volume II. Final report, July 16, 1979-March 31, 1981.** (Sandia National Labs., Albuquerque, NM (USA); Northrup, Inc., Hutchins, TX (USA); Bechtel National, Inc., San Francisco, CA (USA); Booz, Allen and Hamilton, Inc., Cleveland, OH (USA)). Mar 1981. Contract AC04-76DP00789. 172p. NTIS, PC A08/MF A01. Order Number DE81028869.

The manufacturing studies completed included site selection and a detailed plan for a manufacturing plant capable of producing 50,000 heliostats per year. These studies identified a 680,000 square foot plant located in the vicinity of Albuquerque, New Mexico as the desired facility. The heliostat components will be installed at sites within a 400 mile radius of the factory. The factory is located in or adjacent to a major city, and the power plant sites will most likely be remotely located so truck transportation becomes the only reasonable alternative. The designs, methods, and procedures involving the field assembly and installation are described. About 50% of the maintenance cost is related to mirror washing. Mechanical maintenance, constituting about 35% of the total, involves clean-up and painting of steel parts. Electrical and electronic components maintenance is also discussed. The cost per installed heliostat and the annual cost of owning, operating and maintaining a collector subsystem for a 50 MWe (peak) solar central receiver electrical power plant are determined. (LEW)

30200 **(SAND—81-8178-Vol.3) Second-generation heliostat development. Volume III. Appendices A-E. Final report, July 16, 1979-March 31, 1981.** (Sandia National Labs., Albuquerque, NM (USA); Northrup, Inc., Hutchins, TX (USA); Bechtel National, Inc., San Francisco, CA (USA); Booz, Allen and Hamilton, Inc., Cleveland, OH (USA)). Mar 1981. Contract AC04-76DP00789. 267p. NTIS, PC A12/MF A01. Order Number DE81028866.

The bill of material of the Northrup heliostat is tabulated. Portions of the drawings defining the heliostat subassemblies and assembly drawings are presented. On-site heliostat assembly and installation are summarized. Trade studies are presented that were performed in the course of the design progression which lead to the current configuration. Studies on wind loads, distribution, and moments, wind and gravity deflections, thermal curvature and stress, stress analysis in 90 mph wind, and drive unit performance are presented. (LEW)

30201 **(SERI/CP—633-1145) Solar thermal energy systems research and advanced development program review.** Hunt, W.A. (comp.). (Solar Energy Research Inst., Golden, CO (USA)). Apr 1981. Contract AC02-77CH00178. 163p. NTIS, PC A08/MF A01.

Separate abstracts have been prepared for 24 papers in this conference. (LEW)

30202 (SERI/CP—633-1145, pp 1-9) **System review: central receiver system.** Yokomizo, C.T. (Sandia National Labs., Livermore, CA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

The central receiver system concept is briefly described and illustrated, and the status and continuing activities of the program are discussed. The sites of solar thermal repowering projects are given and organizations with solar thermal central receiver experience are tabulated. (LEW)

30203 (SERI/CP—633-1145, pp 17-26) **Parabolic dish system development.** Marriott, A.T.; Moynihan, P.I.; Leibowitz, L. (Jet Propulsion Lab., Pasadena, CA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

To help provide some perspective on the parabolic dish development program, three questions are addressed: (1) what requirements have influenced parabolic dish design decisions to date; (2) how has a specific design evolved to meet near-term system-level requirements; (3) what are the longer term requirements, and how will they influence the technology development program. To answer the first question, the market assessment and applications analysis activities are examined to provide a top-level summary of design requirements for first-generation technology now in production. The second question is addressed by an example of a completed design which is now being verified by testing components and subsystems before a complete system is implemented in the field. The example chosen is the Small Community Solar Thermal Power Experiment, a 1-MWe plant using organic Rankine power conversion technology. Finally, some future development activities envisioned for second- and third-generation technology are discussed, with emphasis on subsystems, component, and material requirements.

30204 (SERI/CP—633-1145, pp 39-44) **Solar Thermal Test Facilities Users Association solar fuel and chemicals.** Smith, F.B. Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

The program of the Users Association is surveyed. The roles and responsibilities of the association are listed, and its proposal review procedure and workshops are discussed. Some of the fuel and chemical experiments funded by the Users Association are outlined, including renewable chemical reactions and solar thermal hydrogen production. (LEW)

30205 (SERI/CP—633-1145, pp 99-103) **RAD applied research activities: an overview.** Lefferdo, J.M. (Solar Energy Research Inst., Golden, CO). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

Some high temperature solar thermal experiments are briefly highlighted. The production of calcium carbide at Odeillo small-scale vertical furnace, testing of a high temperature steam receiver at the Advanced Components Test Facility (ACTF), and the sodium heat pipe experiment are described. The feasibility of producing hydrogen as a fuel by decomposing cadmium oxide at 1500°C and the rapid pyrolysis of biomass are mentioned. Testing of a high-temperature ceramic matrix receiver at the Parabolic Dish Test Site, demonstration of a fluidized bed heat exchanger at the ACTF, a demonstration of thermochemical storage at the White Sands Solar Furnace, and the determination of convective losses for both cavity and external central receivers are discussed. (LEW)

30206 (SERI/CP—633-1145, pp 105-110) **Experimental investigation of the convective heat losses from cavity type central receivers.** Kraabel, J.S. (Sandia National Labs., Livermore, CA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

A study is made of the convective and radiative losses from a cavity that simulates a cavity-type solar central receiver. The broad goals are two-fold: to provide information for modeling the losses, and to provide experimental data that can be used to check the resultant predictive schemes. The emphasis is on realistic simulation rather than scale modeling; the interior surface temperatures are in the same range as for actual receivers and the size is large enough to be in the same flow regime.

30207 (SERI/CP—633-1145, pp 111-115) **Overview of the Stanford/NEAR program convective losses from solar central receivers.** Moffat, R.J. (Stanford Univ., CA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

The Stanford/NEAR program is introduced and some of the background is given which led to its inception. The program has two parts. Nielsen Engineering and Research is conducting a series of large-scale experiments on heat losses in mixed convection (a heated vertical surface in a grazing cross wind), and Stanford University is developing a three-dimensional boundary layer code to predict heat transfer under such conditions. Results from the experiments will be used in developing the computer program.

30208 (SERI/CP—633-1145, pp 121-123) **Thermochemical transport test results.** McCrary, J.H. (New Mexico State Univ., Las Cruces); McCrary, G.E.; Chubb, T.A. Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

Single coil reforming receiver elements are individually tested in an environment similar to that encountered in a solar furnace. The receiver under test is described, as is the testing procedure. Two solar energy receivers have been assembled and operated. Both were designed to operate in the 900 to 1000°C converter temperature range with a 3 CO_2 + CH_4 feedstock mixture for forming an energy-rich synthesis gas. (LEW)

30209 **(SERI/TR—631-1122) Organic Rankine cycle coupled to a solar pond by direct-contact heat exchange: selection of a working fluid.** Wright, J.D. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1981. Contract AC02-77CH00178. 35p. NTIS, PC A03/MF A01. Order Number DE81028400.

Heat from a solar pond may be used to drive an organic Rankine cycle and produce electricity. Due to the inherent low efficiency of low-temperature cycles, large amounts of heat must be transferred, and heat exchangers may account for up to 50% of the plant cost. Use of a direct-contact boiler, in which the organic fluid is bubbled through a stream of pond brine, may reduce the plant cost by about 25%. The choice of a working fluid affects plant efficiency, turbine cost, and the loss rate of the organic fluid. Low-vapor-pressure fluids maximize cycle efficiency by minimizing pumping requirements, but require a larger turbine. Because efficiency affects the size and cost of the entire plant, low-pressure fluids are preferred. Both the saturated and halogenated hydrocarbons were evaluated for use as working fluids. Pentane was the working fluid best suited to this application, because it showed high efficiency, low solubility in the pond, and a reasonable turbine cost.

30210 **High-flux solar absorber concept for central receiver power plants.** Pomeroy, B.D.; Roberts, J.M.; Narayanan, T.V. (GE, Schenectady, NY). *Transactions of the ASME (American Society of Mechanical Engineers)* ; **103**: No. 1, 52-55(Feb 1981).

An absorber concept is described which uses liquid sodium coolant and a three-header configuration to efficiently capture solar power. The mechanical design of this absorber is discussed and thermal performance estimates are presented showing the solar-capture efficiency over a range of solar intensities. The sodium-flow characteristics and some potential flow-control problems are also described. 7 refs.

30211 **Designing a solar total-energy system for an industrial plant.** Knisley, J.R. *Electrical Construction and Maintenance* ; **79**: No. 8, 68-72(Aug 1980).

A distributed parabolic dish collector total-energy system for a 25,000 ft² knitwear factory in central Georgia is described. A meteorological station consisting of eight solar radiation and surface weather instruments, mounting structures, and a cassette tape data logger is also described. Instrumentation for measuring the operating load profiles is discussed. (LEW)

30212 **(DOE/ET/20183—T1) Testing of the 1-MWth bench-model cavity-receiver steam generator.** (Martin Marietta Corp., Denver, CO (USA)). [nd]. Contract AC03-76ET20183. 30p. NTIS, PC A03/MF A01. Order Number DE81026142.

A schematic of the Bench cavity receiver system is given, and the primary objectives, schedule and research plan for each of four tests are discussed. The tests are: (1) cold flow testing to functionally check all valves and their response using high pressure nitrogen gas; (2) a hot checkout to simulate both steady state and transient flux inputs to the receiver which are expected at the French facility; (3) basic performance using solar energy at the French facility; and (4) ir radiant heat testing. (LEW)

1408 Ocean Thermal Gradient And Salinity Gradient Power Systems

30213 **(DOE/CS/30278—T6) Solar Technology Assessment Project. Volume VII. A review of OTEC.** Yuen, P.C. (Florida Solar Energy Center, Cape Canaveral (USA); Hawaii Univ., Honolulu (USA). Hawaii Natural Energy Inst.). Apr 1981. Contract FC02-79CS30278. 150p. NTIS, PC A07/MF A01. Order Number DE81029008.

The Ocean Thermal Energy Conversion (OTEC) principle is discussed along with general system and cycle types, specific OTEC designs, applications, and the ocean thermal resource. the historic development and present status of OTEC are reviewed. Power system components of the more technically advanced closed-cycle OTEC concept are discussed: heat exchangers, corrosion and biofouling countermeasures, working fluids, ammonia power systems, and on-platform seawater sytems. Several open-cycle features are also discussed. A critical review of the ocean engineering aspects of the OTEC power system is presented. Major subsystems such as platform, cold water pipe, mooring system, dynamic positioning system and power transmission cable system are assessed for their relationships with the ocean environment and with each other. Nine available studies of OTEC costs are reviewed, and tentative comparisons are made between OTEC and traditional fuel costs. OTEC products and markets are considered. Possible environmental and social effects of OTEC development are discussed. International and national laws regulating OTEC plants are reviewed, specifically, the United Nations Third Conference on the Law of the Sea and the Ocean Thermal Energy Conversion Act of 1980. Coast Guard regulations, OSHA laws, and state and local government regulations are also considered as well as attitudes of the utilities. (LEW)

30214 **(LBL—12901) Bibliography of marine turtles in the Gulf of Mexico and Caribbean Sea.** Payne, S.F. (Lawrence Berkeley Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 12p. NTIS, PC A02/MF A01. Order Number DE81025165.

Information on the organisms at proposed Ocean Thermal Energy Conversion (OTEC) sites is required to assess the potential impacts of OTEC power plant operations. To gather information on the distribution, abundance and biology of organisms known to occur in OTEC regions, the Marine Sciences Group at Lawrence Berkeley laboratory conducted literature surveys of those organisms. This bibliography is the product of a literature survey on marine turtles at proposed OTEC sites off Puerto Rico and in the Gulf of Mexico. 126 references.

30215 (LBL—12947) List of fish at a proposed OTEC site off Kahe Point, Hawaii derived from commercial fish records, 1959-1978. Jones, A.T. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01. Order Number DE81028897.

Fish species landed from an area encompassing a proposed Ocean Thermal Energy Conversion (OTEC) site off Kahe Point, Island of Oahu are presented. Over 50 species of fish representing 31 families recorded in twenty years of commercial fish landings are listed with their scientific local Hawaiian and common name.

30216 (LBL—12951) Plume survey OTEC-1 mixed-water discharge, April 11-12, 1981. Noda, E.K.; Bienfang, P.K.; Kimmerer, W.J.; Walsh, T.W. (Lawrence Berkeley Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 122p. NTIS, PC A06/MF A01. Order Number DE81028908.

The environmental effects of mixed cold and warm water discharge from the OTEC-1 system is assessed by a plume survey. The specific objectives of the survey are: (1) to locate and map the physical extent of the thermal plume, both vertically and horizontally and determine the dilution of the discharging effluent with ambient waters as a function of location, and (2) to carry out a biological and water quality sampling program both within and out of the plume. The water quality sampling program involved measurement of dissolved oxygen, salinity and nutrients. The phytoplankton sampling program involves measurements of ATP, chlorophyll-a, and phaeopigments. The zooplankton program involves horizontal net tows both within and out of the plume. (LEW)

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 30189, 30201, 30204, 30205, 30724, 30803, 30803, 30817, 30818

30217 (CONF-810812—35) Seasonal performance factors for active solar systems and heat-pump systems. Reid, R.L.; Abbatiello, L.A. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01. Order Number DE81028569.

From IECEC conference; Atlanta, GA, USA (9 Aug 1981).

Methods of evaluating solar systems are discussed and compared. Heating seasonal performance factor (SPFH) and annual coefficient of performance (ACOP) are selected as being of the most value to the consumer in determining his purchased energy requirements and also allow the direct comparison of solar and heat pump systems. A search of the literature produced seasonal or annual data form 20 solar and 12 heat pump systems that were instrumented well enough to measure the loads and energy consumptions necessary to calculate the SPFH and/or ACOP. Tables of these results shows that well designed solar systems have SPFHs of 1.6 to 2.8 compared to heat pump SPFHs of 1.6 to 2.0. However, the heat pump Annual Cycle Energy System (ACES) ACOP has been measured as 3.1 compared to a projected maximum ACOP for a solar system with heat pump cooling of 2.4 to 2.8.

30218 (CONF-810832—5) Passive cooling and heating program at Oak Ridge National Laboratory for FY-1981. Shapira, H.B.; Kaplan, S.I.; Chester, C.V. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01. Order Number DE81028573.

From DOE passive and hybrid solar energy program update; Washington, DC, USA (9 Aug 1981).

Construction was completed of an earth-sheltered, passively solar heated office-dormitory, the Joint Institute for Heavy Ion Research, designed at ORNL. Instrumentation of the building was designed, procured, and installed. Building performance will be monitored and compared with predictions of the DOE-2 code. A study of the incorporation of vegetation on architecture was conducted by the Harvard School of Design. A final report was issued which is a prototype handbook for the use of vegetation to reduce cooling loads in structures. An experiment to reduce the cooling requirement of mobile homes by shading with fast-growing vines was begun: a maintenance-oriented trellis was constructed and vines were planted. An RFP for the production of a prototype set of reflective insulating blinds was issued.

30219 (DOE/CS/30278—T5) Solar Technology Assessment Project. Volume IV. Solar air conditioning: active, hybrid and passive. (Florida Technological Univ., Cape Canaveral (USA). FL Solar Energy Center; Arizona State Univ., Tempe (USA). Coll. of Architecture). Apr 1981. Contract FC02-79CS30278. 58p. NTIS, PC A04/MF A01. Order Number DE81029005.

The status of absorption cycle solar air conditioning and the Rankine cycle solar cooling system is reviewed. Vapor jet ejector chillers, solar pond based cooling, and photovoltaic compression air conditioning are also briefly discussed. Hybrid solar cooling by direct and indirect evaporative cooling, and dehumidification by desiccation are described and discussed. Passive solar cooling by convective and radiative processes, evaporative cooling by passive processes, and cooling with roof ponds and movable insulation are reviewed. Federal and state involvement in solar cooling is discussed. (LEW)

30220 (DOE/CS/30278—T7) Solar Technology Assessment Project. Volume V. Solar industrial process heat. (Florida Technological Univ., Cape Canaveral (USA). FL Solar Energy Center; Tennessee Univ., Knoxville (USA). Energy, Environment and Resources Center). Apr 1981. Contract FC02-79CS30278. 82p. NTIS, PC A05/MF A01. Order Number DE81029006.

The Solar Industrial Process Heat (SIPH) assessment is done to candidly examine the contribution SIPH is realistically able to make in the near and long-term energy futures of the United States. The performance history of government and privately funded SIPH demonstration projects and the present status of SIPH technology are discussed. Before making final recommendations, the influence of economic and socio-political factors (which have a very large effect on the acceptability and application of any new, alternate energy technology) are considered also. Focus is on evacuated tube, parabolic trough, and multiple reflector solar collectors. Auxiliary equipment which is part of a SIPH system such as pumps, blowers, controls, and heat exchangers and storage (where applicable) are discussed also.

30221 (DOE/CS/30278—T12) Solar Technology Assessment Project. Volume III. Active space heating and hot water supply with solar energy. Karaki, S.; Loef, G.O.G. (Florida Technological Univ., Cape Canaveral (USA). FL Solar Energy Center; Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Apr 1981. Contract FC02-79CS30278. 35p. NTIS, PC A03/MF A01. Order Number DE81029004.

Several types of solar water heaters are described and assessed. These include thermosiphon water heaters and pump circulation water heaters. Auxiliary water heating is briefly discussed, and new and retrofit systems are compared. Liquid-based space heating systems and solar air heaters are described and assessed, auxiliary space heating are discussed, and new and retrofit solar space heating systems are compared. The status of flat-plate collectors, evacuated tube collectors, and thermal storage systems is examined. Systems improvements, reliability, durability and maintenance are discussed. The economic assessment of space and water heating systems includes a comparison of new systems costs with conventional fuels, and sales history and projections. The variety of participants in the solar industry and users of solar heat is discussed, and various incentives and barriers to solar heating are examined. Several policy implications are discussed, and specific government actions are recommended. (LEW)

30222 (DOE/CS/30278—T16) Solar Technology Assessment Project. Volume II. Passive solar technology. (Florida Technological Univ., Cape Canaveral (USA). FL Solar Energy Center; Yale Univ., New Haven, CT (USA)). Apr 1981. Contract FC02-79CS30278. 61p. NTIS, PC A04/MF A01. Order Number DE81029003.

The status of passive solar heating and cooling for residential, commercial, and agricultural applications, and of daylighting is summarized. Passive solar energy is used in the broad sense describing a comprehensive approach to design that considers all climatic impacts on a building, and includes planning on the multi-building scale. The key roles of the designer and of innovation in the build-

ing industry are discussed. Numerous terms are defined and the origins of several are discussed. Passive design principles are summarized. Performance and costs of passive solar technologies are examined. Passive energy design tools and methods are considered in the context of the overall process by which building decisions are made to achieve the integration of new techniques into conventional design. (LEW)

30223 **(DOE/CS/31217—T5) Conceptual design report for application of solar energy to the manufacture of concrete block.** (AAI Corp., Baltimore, MD (USA)). Aug 1976. Contract AC03-76CS31217. 34p. NTIS, PC A03/MF A01. Order Number DE81023618.

A solar heating system design is shown which will provide hot process water to augment the hot process water needed for the operation of the concrete block manufacturing process. The system consists of the solar collector array, fluid transfer system with controls, and a control and monitoring system. (MHR)

30224 **(DOE/CS/31218—T3) Application of solar energy to the supply of industrial-process hot water. Second bymonthly cost report: Project term March 15, 1976-December 15, 1976. Progress report, March 15, 1976-July 11, 1976.** Vindum, J.O. (Acurex Corp., Mountain View, CA (USA)). 14 Jul 1976. Contract AC03-76CS31218. 3p. NTIS, PC A02/MF A01. Order Number DE81023624.

The cost status for each task is tabulated and the cumulative cost and estimated cost spending curve is shown.

30225 **(DOE/CS/31218—T4) Application of solar energy to the supply of industrial-process hot water. Preliminary design and performance report. Volume II. Phase II: cost.** (Acurex Corp., Mountain View, CA (USA). Aerotherm Div.). 14 Oct 1976. Contract AC03-76CS31218. 60p. NTIS, PC A04/MF A01. Order Number DE81023626.

Steps taken to eliminate cost overruns or delay of the proposed installation schedule are listed. The cost detail includes the following: total program summary, labor summary, equipment summary without data system, data acquisition equipment, modifications to the process or building, consultants, subcontracts, and cost quotations. (MHR)

30226 **(DOE/CS/31218—T5) Solar production of industrial-process hot water. Quarterly performance report, April-June 1980.** (Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.). 1980. Contract AC03-76CS31218. 6p. NTIS, PC A02/MF A01. Order Number DE81027025.

The performance of the Campbell Soup solar hot water facility is summarized for April through June 1980. These results were tabulated from each of the monthly performance reports. Data taken during this period shows that the system is operating with excellent reliability (100 percent for the 3 month period) with no days of operation lost due to solar system downtime.

30227 **(DOE/CS/31220—T9) Application of solar energy to the supply of hot water for textile dyeing.** (General Electric Co., Philadelphia, PA (USA)). 22 Oct 1976. Contract AC03-76CS31220. 176p. NTIS, PC A09/MF A01. Order Number DE81026073.

The hot water processing demand in textile dyeing and finishing mills throughout the US was studied. This information was employed in choosing the type solar collector system to afford a significant fuel savings in these mills. Economic pictures were developed from these inputs along with current fuel price scenarios, for initiating a plan for solarization in the industry.

30228 **(DOE/CS/31524—T1) San Anselmo Solar Project. Final report.** (McCaughey and Smith Energy Associates, Inc., Tustin, CA (USA)). Jun 1980. Contract FC03-77CS31524. 89p. NTIS, PC A05/MF A01. Order Number DE81027686.

A modern, one-story school building south of San Jose, CA has been equipped with a solar heating and cooling system, consisting of concentrating collectors an absorption air conditioning unit, and a storage tank. The solar HVAC system is described in detail with the aid of several drawings. System performance was calculated using a proprietary computer program which calculates hourly energy collected and used taking into account climatic factors, collector characteristics and system losses. Some performance computations and miscellaneous supporting materials are appended. (LEW)

30229 **(DOE/CS/32128—T2) Operation and maintenance of the Sol-Dance Building solar system. Final report.** Gaultney, J.R. (Wolfe Co., Inc., Albuquerque, NM (USA)). 29 Jul 1980. Contract FC03-78CS32128. 143p. NTIS, PC A07/MF A01. Order Number DE81026638.

A 16,400 square foot general office facility has its primary heating provided by a flat plate solar system using hydronic storage and water-to-air transfer coils for distribution. Backup heat is provided by 10 individually controlled air source heat pumps ranging from 3 tons to 5 tons in capacity. These heat pumps also contain electric resistive elements for use during extremely low ambient temperatures. Cooling is also provided by the heat pumps. Each of the two buildings contains a separate domestic hot water system. Primary heat is provided by a closed loop solar unit with electric elements providing backup heat. A 10,000 gallon black steel water tank provides heat storage.

30230 **(DOE/CS/32139—T1) Church of the Valley, San Ramon, California. Final technical report.** (Hardison and Komatsu Associates, San Francisco, CA (USA)). 24 Jul 1979. Contract FC03-78CS32139. 98p. NTIS, PC A05/MF A01. Order Number DE81029356.

The solar energy system of the church is a hydronic, draindown system providing space heating and natural cooling. Space heating loads are reduced by using insulation well in excess of regulations, and by using double glazing throughout with weatherstripping and door seals at all exterior openings. Cooling loads are reduced by reducing radiant gain during the hot dry summers and autumns. The control system enables the building to take advantage of the high daily temperature variations. Natural ventilation is used to take advantage of the prevailing breezes during the cooling season. Natural lighting is combined with efficient use of artificial light. Projections of energy use and of solar system performance are made and life-cycle costs are analyzed. Acceptance test information, the operations and maintenance manual, and as-built drawings are appended. (LEW)

30231 **(DOE/ET/20194—T3) Industrial applications of solar energy. First quarterly progress report.** Rogan, J.E. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Jan 1976. Contract AC03-76ET20194. 117p. NTIS, PC A06/MF A01. Order Number DE81027058.

The objective of this program is to define solar energy systems that are technically and economically feasible, can satisfy all or part of selected industry demands, and to determine the market potential for such systems. The primary emphasis is placed on the application of total energy systems where industrial process heat, electrical needs, and space heating and cooling requirements are satisfied with a single solar collector field at maximum possible efficiency. Industrial energy usage in the United States and the Southwest was surveyed to determine which industries were most energy intensive. This resulted in the selection of six major groups: (1) Chemicals and Allied Products - SIC 28, (2) Primary Metals - SIC 33, (3) Petroleum and Coal Products - SIC 29, (4) Paper and Allied Products - SIC 26, (5) Stone, Clay, and Glass Products - SIC 32, and (6) Food and Kindred Products - SIC 20. These groupings account for approximately 80% of the total industrial energy usage, both nationwide and within the Southwest. These major groups were then pursued through their subdivisions to determine more specifically the largest energy users and their locations within the Southwest, allowing the final industry selection. Approximately 300 representatives of the selected industries were contacted to determine their specific energy requirements as well as architecturally related energy parameters. Climatic and seismic data is also being collected for the areas encompassing the selected regions.

30232 (DOE/SF/01952—T1) Solar-wood stove domestic heating systems. Final report. Morghen, K.; Soloman, B.; Sussman, A.J.; Carter, J.; Conrat, R. (Sierra Nevada Coll., Incline Village (USA); Sussman (Arthur J.), Point Arena, CA (USA); Mill Creek Energy Sunworks, Healdsburg, CA (USA)). Dec 1980. Contract FG03-78SF01952;FG03-78SF01933;FG03-79SF10553;FG03-79SF10564. 72p. NTIS, PC A04/MF A01. Order Number DE81027822.

Sierra Nevada College developed and tested a residential/commercial wood-stove system as a back-up to a solar active system. The wood-stove was designed to produce both hot water and hot air. The original stove design was modified during testing in order to improve system performance. In particular, a preheater was added, and the stove was modified to supply hot water from a coil around the chimney and hot air from a jacket around the combustion chamber. Its use as a back-up system for solar was compared with a conventional gas system. The results indicated no appreciable cost differences between the two back-up systems, although gas required less labor and maintenance. Another grant was awarded to design, construct and test a stovepipe water heater with bypass section as a complement to a solar water heater. The first prototype did not meet the demand for adequate hot water production due to excessive creosote accumulation on the coils, which reduced hot water production. The second prototype utilized firebox heat exchangers and regulated the amount of hot water by means of a movable shield. This prototype still did not produce as much hot water as desired. A third prototype was developed which incorporated a flue control. This final prototype provided satisfactory hot water production and excellent regulation of output. The last grant was awarded to Mill Creek Energy Sunworks to install and monitor four different configurations of solar-woodstove domestic heating systems, to develop optimized system design parameters and to determine the cost-effectiveness of this approach to domestic water heating.

30233 (EPRI-EA—1957) Supply problems in the solar heating and cooling industry. Final report. (DHR, Inc., Washington, DC (USA)). Aug 1981. 33p. NTIS, PC A03/MF A01. Order Number DE81903739.

Future distribution channels and costs in the solar-heating-and-cooling industry are discussed and some of the external factors influencing the industry are examined such as public policy initiatives and competing technologies. The distribution channels through which solar equipment passes from manufacturer to consumer are examined; future industry evolution will most likely be towards a multiplicity of distribution networks, each serving a different market segment. The components of solar costs, including collector, other system components, indirect and marketing, and installation and O & M costs, are also reviewed. Costs for high quality solar collectors are projected to increase, however the rate of increase is uncertain. Solar costs could increase at: (a) construction industry cost escalation rates; (b) general economic inflation rates; or (c) lower than the general inflation rate. Nevertheless, the average price paid by consumers is expected to increase at slightly less than the rate of inflation because lower-quality, low-priced systems are expected to garner a larger share of future solar sales. Pertinent public policy initiatives are reviewed which may critically influence the development of solar energy, and the impact of competing energy sources on solar heating economics is considered. Consideration of the projections for the aforementioned supply characteristics suggests that product supply may have a significant constraining influence on the growth of the solar industry.

30234 (LA—8892-T) Economic implications of passive-solar retrofit for single-family residences in Albuquerque, New Mexico: a case study. Martin, S.W. (Los Alamos National Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 125p. NTIS, PC A06/MF A01. Order Number DE81028402.

Thesis.

A general methodology is explored whereby certain technical and economic considerations are examined as they relate to the retrofitting of selected passive solar systems onto existing single-family residences in Albuquerque, New Mexico. The analysis provides estimates regarding the characteristics of the existing housing stock in Albuquerque, New Mexico. Certain economic criteria are used to evaluate the potential of retrofitted passive solar systems. Actual system and labor costs along with calculated Input-Output income and employment multipliers are used to estimate changes in income and employment levels within the study area. Estimates of changing energy use patterns also are presented. The methodology presented can be expanded to include other technologies and can be used to examine other potential scenarios.

30235 (LA-UR—81-2200) Passive-solar-retrofit study for the United States Navy. Wray, W.O.; Miles, C.R. (Los Alamos National Lab., NM (USA); Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810925—7). NTIS, PC A02/MF A01. Order Number DE81028921.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

A passive solar retrofit study has been conducted for the United States Navy at the Los Alamos National Laboratory. The purpose of the study was to determine the energy savings obtainable in concrete block buildings from several passive solar heating strategies. A procedure involving the use of test cell data and computer simulation was employed to assess the merits of six retrofit options. The six strategies selected were chosen on the basis of providing a series of options that will deliver increasing energy savings at the cost of correspondingly increased levels of commitment.

30236 (LA-UR—81-2209) Passive solar analysis and design of commercial buildings using DOE-2. Hunn, B.D. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810832—4). NTIS, PC A02/MF A01. Order Number DE81028737.

From DOE passive and hybrid solar energy program update; Washington, DC, USA (9 Aug 1981).

The custom weighting-factor loads calculative method that was implemented in the DOE-2.1 program was refined and fully documented. This method allows direct-gain and night-ventilative-cooling passive systems to be analyzed using DOE-2. A thermal storage wall model for DOE-2 was developed and tested.This model treats vented and unvented storage walls using either masonry or water as the storage medium. It includes the effect of night insulation and selective surfaces. A model for attached sunspaces, atriums, and buffer spaces has also been developed for DOE-2. This model simulates interzone convection (forced or natural), and interzone conduction through massive walls. A case study of Warner Hall at Carnegie-Mellon University in Pittsburgh, Pennsylvania was completed, as part of the DOE Passive Solar Commercial Buildings Program. DOE-2 was used in an analysis of several passive solar and energy conservation retrofit options. The Los Alamos analysis served as a basis for comparison to a more limited (in time and budget) analysis done by the energy consultant for the retrofit project.

30237 (PB—81-114480) A solar heating plant in Studsvik: design and first-year operational performance. Roseen, R.; Perers, B. (Swedish Council for Building Research, Stockholm). 1980. 98p. NTIS, PC A05/MF A01.

Group solar heating plants offer one of the most promising ways of economically utilizing solar energy for space heating purposes. A relatively advanced prototype installation has been built at Studsvik on the Swedish east coast south of Stockholm. The installation is based on a cheap, excavated and insulated water store with a floating insulating cover. The solar collectors are mounted on the cover, which turns to track the sun. This increases the efficiency of the concentrating collectors by between 30 and 50 percent. The heat is used as the sole heat source for an adjacent office building, designed for low-temperature heating.

30238 (PB—81-123374) A Swedish group solar heating plant with seasonal storage: Technical-economic description of the Lambohov Project. Norbaeck, K.; Hallenberg, J. (Swedish Council for Building Research, Stockholm). 1980. 49p. NTIS, PC A03/MF A01.

The group solar heating plant described in this report has been built to provide 55 terraced houses in Lambohov with energy for space heating and the production of domestic hot water. Solar collectors mounted on the roofs of the houses supply hot water to

an excavated water store blasted into the bedrock. The solar collectors pick up energy from February to October. The solar energy collected suffices to meet about 88-95% of the annual energy requirements.

30239 (SAND—81-0763) **Handbook for the conceptual design of parabolic trough solar energy systems process heat applications.** Harrigan, R.W. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 320p. NTIS, PC A14/MF A01. Order Number DE81029290.

This report presents the techniques needed to execute conceptual designs of process heat systems employing parabolic trough solar collectors. The design tools are presented in graphical format, and each of 26 SOLMET sites is explicitly represented. The conceptual design resultant from the application of the design charts contained within this handbook approximates the collector area needed to displace a constant thermal demand, the land area needed for collector deployment, the appropriate quantity of sensible heat storage, the fraction of fossil fuel displaced by solar, and the capital cost of the collector-storage subsystem.

30240 (SAND—81-1300) **Modular industrial solar retrofit system constraints, specifications, and guidelines.** Wally, K. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 60p. NTIS, PC A04/MF A01. Order Number DE81029289.

A programmatic, physical and regulatory reference environment for which Modular Industrial Solar Retrofit (MISR) systems shall be designed is defined. This encompasses a large segment of process steam applications, so that system designs developed for it will be widely applicable with little or no modification. Minimum design requirements at all levels are detailed, and design methodologies, features, and practices are recommended for consideration in any MISR design. (LEW)

30241 (SERI/CP—633-1145, pp 27-32) **Solar ponds: status of the technology and national program.** Sargent, S.L. (SERI, Golden, CO). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

The current state of the art in solar pond technology is described, further research and development requirements are surveyed, and the state of the national solar pond program is assessed.

30242 (SERI/CP—633-1145, pp 45-47) **Solar retorting of oil shale.** Gregg, D.W.; Aiman, W.R.; Taylor, R.W. (Lawrence Livermore National Lab., CA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

The basic logic of the process is addressed, and a preliminary technical and economic analysis is presented. (LEW)

30243 (SERI/CP—633-1145, pp 49) **Design and operation of a solar fired biomass flash pyrolysis reactor.** Antal, M.J. Jr. (Princeton Univ., NJ); Hofmann, L.; Moreira, J.R.; Brown, C.T.; Steenblick, R. Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

30244 (SERI/CP—633-1145, pp 125-129) **Market potential for high temperature process heat.** Iannucci, J.J.; Melius, C.F. (Sandia National Labs., Livermore, CA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

To provide a complementary perspective on the US industrial process heat market, an analysis is done on the types of process heat currently used. All process heat (even at a given temperature) is not equally easy to replace with solar energy. A breakdown of the process heat market by detailed type (steam, direct heat, indirect heat, etc.) is presented.

30245 (SERI/CP—761-1077(Vol.2), pp 101-114) **Solar energy utilisation in Papua, New Guinea.** Ahmad, Q.A. Mar 1981. NTIS, PC A07/MF A01.

From Solar desalination workshop; Denver, CO, USA (23 Mar 1981).

Present areas of solar energy development are described. These include: production of alcohol from cassava, solar water heaters, solar refrigerators and ice makers, solar water pumps, solar air-conditioners, solar ponds, and photovoltaic solar panels. It is expected that the government will subsidize and encourage these developments at the early stages. 6 references.

30246 (SERI/CP—761-1077(Vol.2)) **Solar desalination workshop.** (Solar Energy Research Inst., Golden, CO (USA)). Mar 1981. Contract AC02-77CH00178. 147p. (CONF-810353—(Vol.2)). NTIS, PC A07/MF A01.

From Solar desalination workshop; Denver, CO, USA (23 Mar 1981).

Separate abstracts were prepared for the thirteen included papers.

30247 (SERI/TP—721-1167R) **Solar explosion.** Baccei, B.C. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1981. Contract AC02-77CH00178. 5p. (CONF-810925—13). NTIS, PC A02/MF A01. Order Number DE81026086.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

The Solar Energy Research Institute (SERI) and the Department of Energy (DOE) Passive Solar Manufactured Buildings and Solar Home Builders Programs are developing much needed cost and performance data on solar buildings produced by large-volume home builders. These programs also serve as a model on how government can work effectively with industry.

30248 (SERI/TP—721-1300) **Comparison of residential window distributions and effects of mass and insulation.** Hannifan, M.; Christensen, C.; Perkins, R. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1981. Contract AC02-77CH00178. 7p. (CONF-810925—9). NTIS, PC A02/MF A01. Order Number DE81027938.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

The energy requirements and comfort implications of various window distributions and window areas (representing conventional, sun-tempered, and passive solar designs) are investigated for single-family residences in Albuquerque, NM, Denver, CO, and Madison, WI. Three distinct mass levels ranging from lightweight to heavyweight interiors and three distinct insulation levels, including energy-conserving, night-insulated, and superinsulated cases, are analyzed. Energy requirements are reported for residences with electric resistance heating and mechanical air conditioning. Comfort conditions reported are based on interior average air temperatures and mean-squared errors.

30249 (SERI/TP—721-1312) **Interior design for passive solar homes.** Breen, J.C. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1981. Contract AC02-77CH00178. 7p. (CONF-810925—10). NTIS, PC A02/MF A01. Order Number DE81027939.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

The increasing emphasis on refinement of passive solar systems has brought recognition to interior design as an integral part of passive solar architecture. Interior design can be used as a fine-tuning tool minimizing many of the problems associated with passive solar energy use in residential buildings. In addition, treatment of interior space in solar model homes may be a prime factor in determining sales success. A new style of interior design is evolving in response to changes in building form incorporating passive solar design features. The psychology behind passive solar architecture is reflected in interiors, and selection of interior components increasingly depends on the functional suitability of various interior elements.

30250 (SERI/TP—721-1317) Summertime results from the Class B passive-solar performance-monitoring program. Swisher, J. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1981. Contract AC02-77CH00178. 3p. (CONF-810925—8). NTIS, PC A02/MF A01. Order Number DE81025471.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

The DOE/SERI Class B passive solar monitoring program is designed to provide, at relatively low cost, accurate and consistent real-time estimates of building thermal performance, as well as detailed data regarding climate, indoor temperatures, and purchased energy needs. As part of this program, a microprocessor-based data acquisition system has been installed in each of ten passive solar houses in the Denver area, primarily to evaluate heating-season performance. During the summer, however, the monitoring systems are used to study the overheating tendencies of the buildings. Examination of the conditions that lead to overheating, using graphical and statistical techniques, will provide insight into the solar design practices that provide the most comfortable summer environment.

30251 (SERI/TP—721-1325) Performance analysis of 11 Denver Metro passive homes. Claridge, D.E.; Simms, D.A. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1981. Contract AC02-77CH00178. 7p. (CONF-810925—12). NTIS, PC A02/MF A01. Order Number DE81025473.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

The Solar Energy Research Institute (SERI) sponsored the Denver Metro Solar Homebuilders Program in cooperation with the Department of Energy and Western SUN. The auxiliary heating requirements for 11 of the passive solar homes were calculated using SLR or SUNCAT-2.4 with a standard set of basic assumptions. The analysis shows that seven of the homes should use less than half as much heating fuel as typical houses recently built in the area; two should use about half; and two should use about two-thirds or more. Comparing these results with performance estimates provided by design consultants shows numerous large discrepancies. These differences can be attributed largely to specific differences in assumptions in every case but one.

30252 (SERI-TP—721-1326) Comparative study of four building energy simulations: Phase II; DOE-2.1, BLAST-3.0, SUNCAT-2.4, and DEROB-4. Judkoff, R.; Wortman, D.; O'Doherty, B. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1981. Contract AC02-77CH00178. 6p. (CONF-810925—14). NTIS, PC A02/MF A01. Order Number DE81025472.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

Four building energy analysis codes are compared using two direct gain building models with Madison, WI, and Albuquerque, NM, typical meteorological year (TMY) data. Annual heating and cooling loads are compared and analyzed with respect to two previous studies. The results from all four codes disagree significantly.

30253 (SERI/TP—721-1332) Graphical method to analyze dynamic response of passive buildings. Subbarao, K.; Anderson, J.V. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1981. Contract AC02-77CH00178. 4p. (CONF-810925—18). NTIS, PC A02/MF A01. Order Number DE81028974.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

Just as the steady state behavior of a building can be understood by adding the UA values of the components, the dynamic behavior can be understood by adding vectors giving the response of the components to driving functions of any given frequency (e.g. the diurnal frequency). The vector addition can be done graphically to obtain an intuitive understanding of the role of each component. The interaction of a component with all the others can be included simply by changing the amplitude and phase of the contribution of the component. Combinations of direct gain and Trombe wall can be analyzed in this manner. Work is underway (a) to correlate the response to diurnal frequency directly to auxiliary energy as well as overheating problems and cooling season performance, and (b) to include other passive systems, movable insulation, etc.

30254 (SERI/TP—721-1342) Flexibilities in passive design: examining some limiting solar myths. Derickson, R.G.; Sadlon, K.S. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1981. Contract AC02-77CH00178. 5p. (CONF-810925—15). NTIS, PC A02/MF A01. Order Number DE81028401.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

Some examples of frequently cited rules-of-thumb or general guidelines are examined that needlessly limit designer choice and freedom. Specifically, it is found that a rectangular design with an E-W elongation is not really essential to proper passive design, east and west windows do not necessarily detract from passive heating performance or negatively impact cooling efficiency, and a passive house need not be crammed with thermal mass. Some flexible design alternatives are explored and factors other than E-W elongation, windows, and thermal mass are considered. (LEW)

30255 (SERI/TR—632-385R) Preliminary operational results of the low-temperature-solar industrial-process-heat field tests. Kutscher, C.F.; Davenport, R.L. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1981. Contract AC02-77CH00178. 43p. NTIS, PC A03/MF A01. Order Number DE81029129.

Seven solar industrial process heat field tests funded by the US Department of Energy have been in operation for a year or more-three are hot water systems and four are hot air systems. All are low-temperature projects (process heat at temperatures below 212°F). This report presents performance results gathered by each contractor's data acquisition system and summarizes project costs and problems encountered. Flat-plate, evacuated-tube, and line-focus collectors are all represented in the program, with collector array areas ranging from 2500 to 21,000 ft^2. Collector array efficiencies ranged from 12% to 36% with net system efficiences from 8% to 33%. Low efficiencies are attributable in some cases to high thermal losses and, for the two projects using air collectors, are due in part to high parasitic power consumption. Problems have included industrial effluents on collectors, glazing and absorber surface failures, excessive thermal losses, freezing and overheating, control problems, and data acquisition system failure. With design and data acquisition costs excluded costs of the projects ranged from \$25/ft^2 to \$87/ft^2 and \$499/(MBtu/yr) to \$1537/(MBtu/yr). The hot-air system in use at Gilroy Foods, Inc., Gilroy, California, the seventh project in the field tests, is covered.

30256 (SOLAR/1047—81/50) Solar project description: first manufactured homes (LOT 219) single family residence, Lubbock, Texas. Moore, D. (Boeing Co., Seattle, WA (USA)). 21 Aug 1981. Contract AB01-76CS31020. 50p. NTIS, PC A03/MF A01. Order Number DE81028120.

A system designed to provide solar space heating and to preheat domestic hot water is described. The system consists of nine Payne flat-plate air collectors with a gross area of 288 square feet, a storage bin containing 20,250 pounds of rock, ductwork, and an air-to-liquid heat exchanger for water preheating. The collector, storage, energy-to-load, and auxiliary subsystems are thoroughly described. Operation of the solar and auxiliary systems may involve one or more of five modes of operation: collector-to-storage, direct solar-to-space heating, storage-to-space heating, preheating domestic hot water, and auxiliary space heating. Original cost estimates for provisioning and installation of the solar system are given. The house is instrumented for the National Solar Data Network. (LEW)

30257 End-use matching of solar energy systems. Kreith, F.; Kearney, D.; Bejan, A. (Sol Energy Res Inst, Golden, Colo). *Energy (Oxford) ;* **5**: No. 8-9, 875-890(Aug-Sep 1980).

End-use matching is a procedure for introducing solar energy into the national energy infrastructure. The result of end-use matching is an identification of the most cost-effective combination of process energy needs, solar collector technology, geographic location, and economics by matching currently available solar system hardware with particular industrial processes and their locations. End-use matching is not intended to be a design tool for a specific

plant, but rather a planning tool for determining where and why general applications solar systems appear economically viable in the near future. This paper discusses the end-use matching methodology, and illustrates first and second law thermodynamics analyses applied to a solar system producing process steam. A brief discussion of the paper is appended. 5 refs.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 30119, 30154, 30196, 30197, 30203, 30209, 30239, 30241, 30282, 30996

30258 **(AD-A—091085) Experimental study of the thermal performance parameters of a liquid-heating flat plate solar collector. Master's thesis.** Woodrum, C.D. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Sep 1980. 122p. NTIS, PC A06/MF A01.

From the results of this investigaiton the following conclusions are drawn: (1) The use of turbulators greatly enhanced the internal heat transfer coefficient, but unfortunately, made little difference in the overall performance; (2) The use of turbulators improved flow uniformity by increasing the pressure drop in the tubes; (3) The diameter of the headers should be larger to help ensure flow uniformity. This is especially true for low flowrate conditions such as those tested; (4) The bond conductance for the clamped fin was competitive with soldering since little gain in performance is realized after a value of 20 B/hr-ft-F is achieved; (5) The bond conductance of the woven fin configuration was unacceptable; and (6) Kalwall material was essentially opaque to far infrared radiation.

30259 **(DOE/CS/32117—T1) Development of low-cost integrated zeolite collector. Final report, September 25, 1978-September 24, 1980.** Tchernev, D.I. (Zeopower Co., Natick, MA (USA)). Jul 1981. Contract AC03-78CS32117. 96p. (DOE/SAN—2117-1). NTIS, PC A05/MF A01. Order Number DE81027660.

The goal to design, construct and test an integrated solar zeolite collector, capable of providing hot water during the day and chilled water at night, which will act as one-for-one replacement for existing hot water solar collectors was achieved using the following steps: The optimum zeolite loading and the best zeolite for this purpose were determined by careful mathematical analysis, followed by experimental test, to confirm the theoretical results. The integrated collector design was then completed and the collector was constructed. After sealing and vacuum testing the zeolite panels and heat exchangers, the collector was coated with flat black paint and provided with double glazing, aluminum frame and insulation. Preliminary testing indicated close agreement with theoretical predictions of its performance. During the second year of the contract the goal was to evauate the performance of the integrated zeolite collector under different climatic conditions in different parts of the USA. This goal was achieved by constructing 10 integrated zeolite collectors, testing them individually at the plant and installing a completely instrumented pair at each of the following locations: The Anaconda Company Research Lab in Tucson, Arizona, SERI in Golden, Colorado, and the Zeopower Company in Natick, Massachusetts. After correcting many instrumentation and collector failures, the performance of the pairs is as expected.

30260 **(NYSERDA—80-24) Rogers' focusing-heliostat experimental program at Rensselaer Polytechnic Institute.** (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Mechanical Engineering). Dec 1980. 36p. New York State Energy Research and Development Authority, Albany, NY. Order Number DE81903592.

The first objective of this project was continued development of a Fresnel reflector, two-axis tracking, point-focusing solar collector design, whose potential had been successfully demonstrated through construction of four earlier prototypes. Through multiple iterations of component design and construction, major advances were achieved in terms of cost/performance trade-offs for the support structure, mirror support columns, azimuth and elevation drive systems, receiver and microprocessor controls. This sets the stage for the second objective, construction of a full-size unit and integration with the Rensselaer Polytechnic Institute central steam system. During the past six months of testing, the collector has successfully produced 250°F steam at a rate exceeding 160 pounds of steam per hour and at a peak efficiency of 80% and a day-long average efficiency of 68%. Techniques for improving performance of subsequent collectors but about 10% have already been realized. The third objective, technology diffusion, was realized through involvement of over 100 students in projects related to this work and through numerous collector demonstrations before interested public groups. The potential for near-term implementation of this high-performance, low-cost solar technology as a means of reducing consumption of imported and non-renewable indigenous energy resources has been demonstrated.

30261 (SAND—80-8049, pp 115-118) **DOE heliostat development program.** Eicker, P.J. (Sandia National Labs., Livermore, CA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

An overview is given of the important occurrences in the heliostat development program in FY-80 and milestones for FY-81.

30262 (SAND—80-8049, pp 119-126) **Second generation heliostat development.** Gillette, R.B. (Boeing Engineering and Construction Co., Seattle, WA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The prototype heliostat design and its major features are described, and the program plans and status are summarized. (LEW)

30263 (SAND—80-8049, pp 127-130) **Second generation heliostat.** Steinmeyer, D.A. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

Changes are reported in the prototype study heliostat and component configurations where cost reductions can be realized. Heliostat testing is discussed. (LEW)

30264 (SAND—80-8049, pp 131-138) **Design and cost projection of the Martin Marietta second-generation heliostat.** Oldham, L.P. (Martin Marietta Denver Aerospace, CO). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

A low-cost, mass-producible heliostat design has been developed with performance characteristics that would minimize the busbar energy cost of a 50-MWe power plant. The design was to provide a heliostat lifetime of 30 years and have sufficient detail to permit preliminary design of a central manufacturing plant and to prepare cost estimates for the manufacture, transportation, installation, and maintenance of 50,000 heliostats per year. The controls system design task was to provide only a 50-MWe heliostat control system concept and a detailed design for control of two prototype heliostats. The 50-MWe heliostat control system was sufficiently detailed to provide a basis for installed heliostat field cost projections. A preliminary design and a cost projection was conducted for a heliostat central manufacturing facility sized to produce 50,000 heliostats per year and to develop preliminary scenarios, techniques, tool designs, concepts, and costs for the manufacture, transportation, installation, and maintenance of the second-generation heliostats at that production rate. This task was based on installing the heliostats in 50-MWe field sizes located within a 400-mile radius from the central manufacturing plant. The task also included a study to identify the most cost effective plant location in an eight-state region in the southwestern United States.

30265 (SAND—80-8049, pp 139-144) **Second generation heliostat design.** Pietsch, J.A. (Northrup, Inc., Hutchins, TX). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The status of Northrup's heliostat program is reported. The current heliostat design is described, and the installation of prototypes is illustrated. (LEW)

30266 (SAND—80-8049, pp 145-154) **Economic analysis of the unified heliostat array.** Ehrhardt, L.E.; Moore, W.T. (Veda Inc., Camarillo, CA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The Unified Heliostat Array (UHA) is a concept designed to provide industrial process heat from solar energy. In the UHA system the solar receiver is placed near ground levels, close to the industrial process, and a terraced support structure is provided to raise the heliostats into position to reflect the solar energy. The purpose of this study was to determine structure concepts for the UHA, evaluate the optical performance of the UHA using the conventional Repowering Heliostat and the Veda Industrial Heliostat and determine the cost of energy over a range of working temperatures for three power levels-1 MW/sub t/, 10 MW/sub t/, and 25 MW/sub t/.

30267 (SAND—80-8049, pp 155-156) **Issues concerning heliostat commercialization.** Brandt, L.D. (Sandia National Labs., Livermore, CA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

Major sources of information for the commercialization study were discussions with potential heliostat suppliers and previously completed heliostat production cost studies. Heliostat suppliers indicated that the major tasks to be accomplished during commercializatio are: (1) expansion of production rates to exploit economies of scale, (2) development of effective manufacturing processes, and (3) continued design evolution to make heliostats more producible. Over the commercialization period, the cost of heliostats is expected to decline and the processing experience necessary for high-level mass production will be acquired. Programs supported in part by government funding will provide the only significant demands for heliostats in the near term.

30268 (SAND—80-8049, pp 157-168) **Development of an automatic heliostat cleaning system.** Poulin, E.C. (Foster-Miller Associates, Inc., Waltham, MA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

An automatic washing system was designed consisting of a water treatment system, a pressurized underground water distribution system, an automatic spray washing module for each heliostat, a water collection system, and appropriate controls to operate this equipment. In order to determine optimum values for the various washing parameters, a series of washing tests was undertaken in which mirrors were soiled and then cleaned by a high pressure water spray. Reflectivity was measured for the clean, soiled and washed conditions to determine the effectiveness of the cleaning. A heliostat spray module was constructed and operated mainly to obtain information on the mechanical operation of one concept. This testing showed that this system was generally satisfactory, but did show some areas for improvement. The annual cost of washing for an automatic system was found to be a mild function of washing frequency but highly dependent upon monetary parameters. In general, it appears that if the cost of money is 18% then the automatic cleaning system will not be cost effective unless the degradation rate is high and/or the cost of electricity is greater than or equal to $0.08/kWh.

30269 (SAND—80-8049, pp 169-178) **Heliostat materials development and evaluation program.** Griffin, R.N. (General Electric Co., Schenectady, NY). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

Enclosure and reflector materials were produced, characterized, and tested, establishing a data base for the prediction of useful life cycles and upgrading the performance of enclosed heliostat systems, leading to a lower cost/performance ratio. Oriented poly(vinylidene fluoride) (PVDF) film, such as Kynar 460, is markedly well suited to heliostat enclosure applications. Its tensile strength is among the highest of known polymer films, and it has a remarkable ability to recover its original dimensions after at least as much as 33% strain. It has high solar transmittance after prolonged exposure to sunlight. It appears that (barring abrasion) the lifetime of PVDF enclosures may be limited by changes in mechanical properties rather than loss of solar transmittance. Low propagating tear strength is a known weakness of PVDF film. Certain poly(ethylenene terephthalate) (PET) films can be aluminized to produce specular reflectors with an AM 1.5 solar reflectance ~ 0.90. Such reflectors can be protected against oxidation by Dow Corning Q96315 resin with a loss in reflectance on th order of 0.03. Weathering tests to date indicate that such reflectors are stable to extensive solar exposure and even to direct weathering. Second-surface aluminized LLumar reflectors have an AM 1.5 solar reflectance ~ 0.81. Their stability is much higher than would be expected from tests of LLumar as an enclosure material. Second-surface metalized PVDF reflectors should have better stability and higher reflectance, but attempts to make such a reflector have not been successful.

30270 (SAND—80-8049, pp 179-188) **Second generation heliostat (new ideas) low cost mirror module development.** Koenig, A.A.; Hobbs, R.B.; Hogan, J.M. (General Electric Co., Valley Forge, PA). Jan 1981. NTIS, PC A12/MF A01.

From Solar central receiver semi-annual meeting; San Francisco, CA, USA (15 Oct 1980).

The development of a low-cost mirror module for heliostat-power tower applications is based on the identification of materials and production processing techniques which are consistent with a goal of $2.00/ft^2 (assuming reflectivities of 93 to 95%). The use of plastics to achieve weight and cost reduction appears to be a product trend which offers the potential here also to lower mirror module production costs. Three design concepts were considered within the framework of this program: Molded Rib, Extruded Panel, and a Sandwich Approach. Analyses leading to the design selection were undertaken which included material cost, processing costs, and resultant module stiffness and flatness. The premise for the reflector processing in each case was a low-cost sprayed silver precipitate approach. Other low-cost options were considered, such as metallized films and protected chemically polished aluminum, with lower cost requirements due to intrinsically lower performance.

30271 (SAND—81-1541) **Solar energy system design: a simple method for sizing the collector field and thermal storage.** Peters, R.R. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 81p. NTIS, PC A04/MF A01. Order Number DE81028852.

The Zero Marginal Cost (ZMC) technique was developed to enable quick, accurate designs of parabolic trough solar energy systems. The ZMC technique is discussed and it is shown that systems designed with this technique compare quite favorably with those designed using expensive computer codes. Information included allows systems to be designed for four locations: Albuquerque, NM; Dallas, TX; Fresno, CA; and Washington, DC.

30272 (SAND—81-7011) **Conceptual design of a glass-reinforced concrete solar collector.** Slemmons, A.J.; Ploeger, D.W.; Lundgren, R. (Sandia National Labs., Albuquerque, NM (USA); SRI International, Menlo Park, CA (USA)). Jul 1981. Contract AC04-76DP00789. 51p. NTIS, PC A04/MF A01. Order Number DE81029280.

An investigation of the properties and characteristics of glassfiber-reinforced concrete (GRC) was made to determine its suitability as a reflector substrate and structure for heliostats and solar collectors. The material properties and characteristics of GRC were established by tests on small flat panels. A conceptual design of a 2-m x 6-m parabolic trough solar collector module and a preliminary production-cost analysis were also completed.

30273 (SERI/CP—633-1145, pp 11-16) **Overview of line-focus solar thermal collector systems.** Schimmel, W.P. (Sandia National Labs., Albuquerque, NM). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

An overview is given of progress being made toward commercialization by line-focus solar collector systems. The effort to characterize the various types of parabolic trough collectors is dis-

cussed and a trajectory for expected performance with time is presented for several temperatures. An indication is given of the total line-focus collector aperture arising from the several DOE-sponsored projects. Finally, the manner in which the installed capital cost divided by average energy provided by the system is decreasing with time is discussed.

30274 (SERI/CP—633-1145, pp 71-75) **Cermet selective absorber coatings.** Thornton, J.A. (Telic Corp., Santa Monica, CA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

An investigation is described of Pt/Al_2O_3 cermet selective absorber coatings deposited by sputtering. The potential application is for medium and high temperature collectors. This investigation is being conducted using cylindrical-post and planar magnetrons. The substrates are glass, quartz, and type 316 stainless steel plates. Coatings with favorable optical properties, and with strong thermal stability, have been deposited using both direct rf sputtering of alumina and reactive sputtering to deposit the Al_2O_3. Guidelines have been established for selecting coating configurations (thickness, grading profile, and Pt content) to yield various combinations of absorptances and emittances. Particular attention has been given to examining coating configurations which can minimize the required platinum content. Multi-layer AMA-type coatings have been found to be very effective in this respect.

30275 (SERI/CP—633-1145, pp 87-89) **Thin glass for solar thermal applications.** Shoemaker, A.F. (Corning Glass Works, NY). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

Runs of Corning's new 7809 Solar glass are described. The first was made in a small prototype fusion tank in order to verify the properties of the solar glass and to determine if the composition created any problems with fusion forming. The second run was made in a full-scale fusion production facility. Its purpose was to verify scale-up capability and production rates, and also to determine how thin the glass could be made with the existing equipment. Four methods are listed by which glass can be adapted to the parabolic curvature, and concerns about three of them are given. Tests run on the fourth method - flat, 0.9 to 1.27 mm, chemical strengthened-cold formation - have demonstrated its ease of handling and assembly, toughness and high output efficiency. A new glass developed in keeping with these considerations is described. (LEW)

30276 (SERI/CP—633-1145, pp 91-98) **Exposure testing of solar materials.** Anderson, T.E. (DSET Laboratories, Inc., Phoenix, AZ). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

The scope of this program is to subject materials to both real-time and accelerated exposure tests. Optical and physical property measurements are made at periodic intervals, the goal of which will be to report the retention (or loss) of property as a function of exposure. There are several features that distinguish this program from previous materials testing programs: (1) all materials are commercially available and were purchased from distributors or manufacturers without their knowledge of the purpose; (2) exposure intervals are based on the total ultraviolet radiation deposited (specifically in the 300 to 385 nm wavelength region); (3) most of the test methods employed will simulate actual end-use conditions by utilizing special fixtures designed for that purpose. Emphasis will be limited to the test methods selected for absorber materials, and a review of the data obtained thus far.

30277 (SERI/CP—633-1145, pp 117-120) **Fluidized bed solar thermal receiver: test results.** Archer, D.H.; Bachovchin, D.M. (Westinghouse Research and Development Center, Pittsburgh, PA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

The use of a large fluidized bed as a solar thermal receiver has been demonstrated. Standard fluidized bed design techniques are suitable for receiver preliminary design. These techniques, and the use of a cavity, can be used to maximize receiver effectiveness at the appropriate point in the development process, as the most promising applications for these versatile devices are identified.

30278 **Second law analysis and synthesis of solar collector systems.** Bejan, A.; Kearney, D.W.; Kreith, F. (Univ of Colo, Boulder). *Transactions of the ASME (American Society of Mechanical Engineers)* ; **103**: No. 1, 23-28(Feb 1981).

The second law of thermodynamics is used to analyze the potential for energy conservation in solar collector systems. It is shown that the amount of useful energy (exergy) delivered by solar collector systems is affected by heat transfer irreversibilities occurring between the sun and the collector, between the collector and the ambient air, and inside the collector. 19 refs.

30279 **Experimental comparison of control strategies for solar energy systems incorporating dual storage tanks.** Wolfson, R.L.T.; Harvey, H.S. (Middlebury Coll, Vt). *Transactions of the ASME (American Society of Mechanical Engineers)* ; **103**: No. 1, 47-51(Feb 1981).

Two identical solar collector systems were operated side by side for a 67 day period. Data acquisition and control of both systems were accomplished by a minicomputer. One system's control strategy kept its two storage tanks at the same temperature, simulating a single tank. The other system employed a dual temperature strategy designed to allow greater flexibility in adjusting to varying isolation. The dual temperature strategy showed a modest 4 percent gain in energy delivered to a load. 5 refs.

30280 **Statistical model for the incidence of large hailstones on solar collectors.** Cox, M.; Armstrong, P.R. (Atlas Corp, Santa Cruz, Calif). *Solar Energy* ; **26**: No. 2, 97-111(1981).

A statistical model is described for estimating the risk of impacts by large hail on any ground installation (such as a solar collector array). The model is based on data for three frequency distributions: hailstone size, hailfall count (number of hailstones per m/sup 2/ per storm), and number of hailstorms per year. The independence of the three random variables is discussed. 35 refs.

30281 **Study and realization of a plan for a solar collector under vacuum at high performance. Final report.** Dancette, M. Luxembourg; Commission of the European Communities (1980). 108p. (In French). (EUR—6956-FR). European Community Information Service, Washington, DC.

A comparative study of various circuits for evacuated solar collectors indicates that the television cathode tube is best adapted for such purposes because of their ease of fabrication, degree of reliability and low heat loss through the absorber's radiation. Calculated and measured efficiencies of normal solar flux are given for temperatures of 80°C and 120°C. The difference in the flux values (measured as W/m^2) is attributed to selective surface degradation during the thermal cycle of manufacture at a temperature of 435°C which entails reduced absorption. The selection of surface adapted to standard temperatures is seen as a resolution of that problem. An initial evaluation of the tested prototype evacuated solar collectors, tested in southern France at a rate of 1500 F/m^2 at a standard of 80°C indicates energy recovery of from 400 to 800 kWh/m^2, depending upon the angle of collector inclination. Those values are found to be 2 to 3 times greater than attainable with a classical selective collector. Prospective uses of such evacuated collectors include the production of hot water for domestic purposes, for industry (temperatures of 80 to 150°C) and cold production, in combination with the use of collectors with an absorption machine.

1420 Heat Storage

REFER ALSO TO CITATION(S) 30241, 30947

30282 **Construction and startup performance of the Miamisburg salt-gradient solar pond.** Wittenberg, L.J.; Harris, M.J. (Monsanto Res Corp, Miamisburg, Ohio). *Transactions of the ASME (American Society of Mechanical Engineers)* ; **103**: No. 1, 11-16(Feb 1981).

The largest salt-gradient solar pond in the U.S. occupies an area of 2020 m/sup 2/ and was installed for only /35/m/sup 2/.

Under steady-state conditions, the pond is conservatively predicted by the authors to deliver over 1015 GJ/yr (962 million Btu) of heat to be used principally for heating an outdoor swimming pool in the summer and an adjacent recreation building from October to December each year. Based upon a 15-yr depreciation of the installation costs, the cost of this heat, /8.95/GJ (/9.45/million Btu) would be below the cost of heating with fuel oil. 13 refs.

15 GEOTHERMAL ENERGY

30283 **Geothermal: energy for the eighties. Volume 4. Transactions.** Davis, CA; Geothermal Resources Council (1980). 847p. (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Two hundred and eight papers are included. Thirty papers were abstracted previously for EDB. Separate abstracts were prepared for one hundred seventy-eight papers. (MHR)

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 30304, 30396

30284 **(AD-A—091786) Fallon Geothermal Exploration Project, Naval Air Station, Fallon, Nevada. Interim report FY 79.** Bruce, J.L. (Naval Weapons Center, China Lake, CA (USA)). May 1980. 51p. NTIS, PC A04/MF A01.

The Fallon Geothermal Exploration Project was developed to determine which Navy-controlled lands near the Naval Air Station (NAS), Fallon, Nevada, had the highest potential for geothermal development. The project studies primarily NAS Fallon and Ranges Bravo 16 and Bravo 19. Some data (mercury study data for the ranges and temperature gradients for NAS Fallon) are incomplete and will later supplement this report. The areas having the highest geothermal development potential are (1) the southern portion of NAS Fallon, located over a fairly shallow thermal anomaly (300 degrees F at a depth of 2400-3000 feet); and (2) the northnorthwest portion of Range Bravo 19, with Lee Hot Springs and intersecting lineaments that could be conduits for geothermal fluids. A detailed regional geophysics study and a dipole-dipole resistivity survey could provide necessary data on the basin structure and other aspects of the Fallon area.

30285 **(SAND—81-0036C) Proceedings of the international conference on geothermal drilling and completion technology.** (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 549p. (CONF-810105—). NTIS, PC A23/MF A01. Order Number DE81021803.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Separate abstracts were prepared for the thirty papers included in this proceedings.

30286 (SAND—81-0036C, pp 1.1-1.8) **Department of Energy and the US geothermal energy program.** Carwile, C. (Dept. of Energy, Washington, DC). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

US geothermal resources are classified according to resource type and estimates of these resources are presented under the categories of (1) maximum resource base, (2) technically recoverable resources, and (3) economically available resources. The objective of the federally funded geothermal program is to accelerate commercial, i.e., nonfederal, development of all types of geothermal energy through resource assessment, leasing of federal lands, demonstrations of various types, loan guaranties, and technology development. The governmental departments and agencies participating in the US geothermal programs are identified and the program of the Department of Energy, the lead agency, is outlined. US geothermal development and utilization goals are also discussed. The past, current, and proposed funding levels of the DOE program and the rationale for these expenditures are summarized.

30287 **Overview and status of the US Department of Energy's Industry-Coupled Geothermal Reservoir Assessment Program.** Fiore, J.N. *Transactions - Geothermal Resources Council ;* **4**: 201-204(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The US Department of Energy's (DOE) cost-sharing Industry-Coupled Program is discussed. Several geothermal reservoirs are being assessed under the Program and a wide range of geothermal reservoir data is being acquired and disseminated in an effort to accelerate the commercialization of geothermal energy. The reservoir assessment techniques include geological, geochemical, geophysical, and drilling methods in 14 distinct work areas throughout northern Nevada and southwestern Utah. From the time of Program implementation to date (May 1980), 11 exploratory wells have been sited and drilled to an average depth of about 7000 feet. Remaining activities include the drilling of up to ten additional exploratory wells before the end of 1981.

30288 **State Coupled Program: a new emphasis.** Foley, D. (Univ. of Utah Research Inst., Salt Lake City); Brophy, G.P.; Mink, L.L.; Blackett, R.E. *Transactions - Geothermal Resources Council ;* **4**: 779-781(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

A slight redirection of state resource assessment team tasks is taking place with the initiation of the User Coupled Confirmation Drilling Program in federal FY '81. State resource teams will conduct statewide inventories of hydrothermal resources in order to prioritize regions for additional work. Regional analysis of information will be done to refine target model concepts of selected areas and generate state resource maps for public use. Direct temperature measurements and indirect geological, geophysical, and geochemical studies will be employed for more detailed area exploration to produce technical maps and reports. Confirmation of specific hydrothermal reservoirs will be accomplished as part of the User Coupled Confirmation Drilling Program.

30289 **Geothermal progress monitor.** Lopez, A.F.; Entingh, D.J.; Neham, E.A. (MITRE Corp., McLean, VA). *Transactions - Geothermal Resources Council ;* **4**: 807-810(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The Geothermal Progress Monitor is sponsored by the Division of Geothermal Energy/Resource Applications, DOE, to assemble the important facts about geothermal development activities in the United States in order to assess the pace of the development of this alternative energy source. The initial emphasis for the monitoring effort has been placed on the detection and analysis of important and simple indicators of what the main participants in geothermal energy utilization - field developers, energy users, and governments - are doing to foster the discovery, confirmation, and especially the use of this resource. The major indicators currently considered to be both important and measurable, are leasing activites, drilling effort, feasibility studies, construction plans and progress, costs of installations, levels of investment, environmental study and regulatory and legislative status of events, and government monetary investments in projects and activities. Additional indicators may be pursued in the future, depending on specific needs for or opportunities to capture relevant data and facts.

30290 **State of Alaska Geothermal Program.** Reeder, J.W.; Motyka, R.J.; Wiltse, M.A. (State of Alaska, Anchorage). Contract FG51-79RO00074. *Transactions - Geothermal Resources Council ;* **4**: 823-826(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The State of Alaska geothermal program presently consists of a regional hot spring reconnaissance project and 15 proposed site-specific projects. The general outline of this program is presented.

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 30295, 30305, 30313, 31319

30291 Chemical and thermal evolution of the Twin Peak magma system, west central Utah. Crecraft, H.R.; Nash, W.P.; Evans, S.H. Jr. (Univ. of Utah, Salt Lake City). Contract AC07-81ID12079. *Transactions - Geothermal Resources Council ;* **4**: 117-120(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

A greater understanding of the evolution of shallow silica magma systems may help interpret the thermal structure of young systems associated with geothermal resources. The Twin Peaks volcanic center of west-central Utah is a small scale shallow silicic magma system which produced four cubic kilometers of exposed volcanics. Chemical modeling of the system's evolution indicates that two pulses of magma gave rise to two separate differentiation sequences, spanning periods of 2.7 to 2.5 m.y. and 2.43 to 2.35 m.y. A sustained heat influx from below is required to maintain the system above its solidus for periods exceeding 50,000 years. The resulting thermal gradient in the magma chamber gives rise to liquid-state differentiation which produces increasingly pronounced chemical gradients in a stagnant roof zone above the convecting bulk of the magma. A distinct pattern of chemical change, characterized by increases in SiO_2, heavy rare earths, H_2O, Na_2O, and highly charged cations, and decreases in FeO, MgO, CaO, K_2O, and light rare earth elements, results. The degree and rate of liquid-state differentiation may indicate the relative magnitude of heat flux from below, and whether heat input is continuing. Chemical changes over the first sequence, spanning about 200,000 years, was dominated by liquid-state differentiation, indicating sustained heat input. The second sequence spanned less than 100,000 years and liquid-state differentiation was considerably less pronounced, suggesting a diminishing heat influx.

30292 Hydrothermal alteration as an indicator of temperature and flow regime in the Cerro Prieto geothermal field of Baja California. Elders, W.A.; Hoagland, J.R.; Williams, A.E. (Univ. of California, Riverside). *Transactions - Geothermal Resources Council ;* **4**: 121-124(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

More than 65 boreholes, 1.5 to 3.5 km deep have encountered temperatures ≦ 350°C and brines with ≦ 1% total dissolved solids in the Cerro Prieto geothermal field of the Salton Trough intracontinental rift system. Temperature-dependence dehydration and decarbonation reactions have produced progressive hydrothermal alteration in the deltaic sediments of the reservoir to form greenschist facies rocks. Various methods of geothermometry were applied, including authigenic mineral assemblages and light stable isotopes, to study temperature distribution and fluid-rock interaction in the subsurface. These data have revealed a pattern of mineral zones and isotopic ratios in the rocks which defines the shape of the reservoir and records the pattern of hydrothermal circulation prior to production. It was inferred that a thermal plume, elongated in a NW-SE direction, dips at 45° to the NE; it is recharged from the NE and discharges to the SW.

30293 Hot dry rock geothermal site evaluation, Western Snake River Plain, Idaho. Arney, B.H. (Los Alamos Scientific Lab., NM); Beyer, J.H.; Simon, D.B.; Tonani, F.B.; Weiss, R.B. *Transactions - Geothermal Resources Council ;* **4**: 197-200(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Geologic, geophysical, hydrologic, and water chemistry studies have been performed to evaluate a hot dry rock geothermal prospect along the northern margin of the Western Snake River Plain, Idaho. The potential reservoir rock, Idaho Batholith granite, outcrops just north of the site, and is step faulted down to the south; it is more than 3 km deep in the southern part of the site. The central and northeastern parts appear to be the most promising for HDR development. Geophysical data suggest: (1) high permeability at depth in the NW corner, and (2) too great a depth to granite in the south. Thermal disturbances from ground water may affect heat flow reported from shallow measurements. Silica geothermometers indicate equilibrium temperature not significantly above the 60 to 80°C measured in hot springs and wells. Future work, including a seismic reflection survey and an exploratory well, is planned to further define the thermal regime, the depth to granite, and its permeability.

30294 Model for a deep conduit to the Beowawe geothermal system, Eureka and Lander Counties, Nevada. Struhsacker, E.M.; Smith, C. (Univ. of Utah Research Inst., Salt Lake City). Contract AC07-80ID12079. *Transactions - Geothermal Resources Council ;* **4**: 249-252(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

A fault set trending N15-35W formed the eastern boundary of a major graben in the Beowawe area in the Late Tertiary. Geologic mapping and dipole-dipole resistivity data suggest that this fault set may have been and continues to be a deep conduit to the Beowawe geothermal system.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 30287, 30293

30295 (DOE/ID/01717—T2) New Mexico State University geothermal production well. Technical completion report, January 1, 1978-December 31, 1979. Chaturvedi, L. (New Mexico State Univ., Las Cruces (USA)). Jan 1981. Contract AS07-78ID01717. 51p. (EMD—77-2218). NTIS, PC A04/MF A01.

The detailed technical specifications for the production well, the lithologic sample analysis, and a suite of geophysical logs, consisting of electrical resistivity, spontaneous potential, gamma ray and neutron, are presented. (MHR)

30296 (PB—81-855678) Gravity surveys for geothermal resources. June 1976-May 1980 (citations from the energy data base). Report for June 1976-May 1980. Frey, J.H. (New England Research Application Center, Storrs, CT (USA)). Aug 1980. 148p. NTIS PC N01/MF N01.

Reports on the exploration for geothermal resources by means of gravity surveys are included in this retrospective bibliography. (Contains 136 citations.)

30297 (SAND—81-0036C, pp 5.1-5.22) **European geothermal drilling experience: problem areas and case studies.** Baron, G. (Commission of the European Communities, Paris, France); Ungemach, P. 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Geothermal drilling has long been restricted in Western Europe to the sole dry steam field of Larderello in Italy. In the last few years, a wider experience is building up as a consequence of intensified exploration and development programs carried out for evaluation and production of both low- and high-enthalpy geothermal resources. A sample of some 40 boreholes indicates the following problem areas. Due to similar settings - hot water system flowing in sedimentary units at temperatures and depths ranging from 40° to 140°C (104° to 284°F) and from 1000 to 3500 metres (3281 to 11,484 feet), respectively - the technology here is strongly dependent on oil and gas drilling practice. Still, specific problems remain in the areas of multiple-reservoir reconnaissance and well completion at production and reinjection levels, particularly in poorly consolidated fluvio-deltaic sequences leading to sand control and swelling clay problems. Expertise needs to be developed to minimize costs, secure high production capacities, long lifetimes, and minimum maintenance compatible with the economics and the lack of suitable workover facilities. Exploratory drilling is currently combining wildcatting and deeper investigations of known fields. Lost circulation, drill string corrosion, tubulars, mud, cementing, and deviation control are the most frequently encountered difficul-

ties while drilling in hostile water-dominated environments. Formation temperatures in excess of 300°C (572°F) are often the rule, and recent drilling conducted in volcanic areas have hit fluids approaching supercritical state. Whenever these problems do not remain under control, they result in rig standby and extra costs which severely penalize an industry which needs sharp improvements to be fully reliable and cost effective.

30298 (SAND—81-0036C, pp 6.1-6.24) **Drilling and completion of the Urach III HDR test well.** Meier, U.; Ernst, P.L. (Preussag AG, Hannover, Germany). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

The hot dry rock (HDR) test well, Urach III, was drilled and completed in 1979. The borehole is located in Southwest Germany in the geothermal anomaly of Urach. The purpose of project Urach was to study drilling and completion problems of HDR wells and to provide a test site for a HDR research program. The Urach III borehole was drilled to a total depth of 3334 metres (10,939 feet), penetrating 1700 metres (5578 feet) into the granitic basement. Extensive coring was required to provide samples for geophysical and geochemical studies. Positive displacement downhole motors were used for coring and normal drilling operations. It was found that these motors in combination with the proper bits gave better results than conventional rotary drilling. Loss of circulation was encountered not only in sedimentary rocks but also in the granite. After drilling and completion of the borehole, a number of hydraulic fracturing experiments were performed in the open hole as well as in the cased section of Urach III. A circulation loop was established by using the single-borehole concept. It is not yet clear whether new fractures have actually been generated or preexisting joints and fissures have been reactivated. Evaluation of the results of this first step is almost completed and the planning of Phase II of the Urach project is under way.

30299 (SAND—81-0036C, pp 30.1-30.16) **Italian experience and problems in deep geothermal drilling.** Cigni, U.; Del Gaudio, P.; Fabbri, F. 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Geothermal exploration at depth is being conducted in the Larderello area of Italy, in order to ascertain whether it is possible to extract geothermal fluids from the layers which underlie the reservoir now being exploited. The main operating problems are caused by the high thermality and the chemical corrosiveness of the fluids encountered; and by the practial problems involved in drilling without circulation to the surface in mainly hard but anhomogenous fractured formations. The technology employed for deep geothermal well drilling plays an important role in this research. In deep geothermal well drilling it is essential that the equipment and the materials employed are suitable for use in areas which are characterized by high thermality and chemical corrosiveness. The results of the experiences gained in Italy concerning the materials and tools employed in deep geothermal exploration are presented. The various problems involved are described in detail and particular mention is made of drift control, fishing operations, cementation of the deep casing, control of the circulation fluid, and choice of the tubular materials.

30300 (SAND—81-7123) **Geothermal-resource verification for Air Force bases.** Grant, P.R. Jr. (Sandia National Labs., Albuquerque, NM (USA); Energy Resources Exploration, Inc., Albuquerque, NM (USA)). Jun 1981. Contract AC04-76DP00789. 56p. NTIS, PC A04/MF A01. Order Number DE81027482.

This report summarizes the various types of geothermal energy reviews some legal uncertainties of the resource and then describes a methodology to evaluate geothermal resources for applications to US Air Force bases. Estimates suggest that exploration costs will be $50,000 to $300,000, which, if favorable, would lead to drilling a $500,000 exploration well. Successful identification and development of a geothermal resource could provide all base, fixed system needs with an inexpensive, renewable energy source.

30301 **Caliper and contour tool.** Fink, C. F. (to to Department of Energy). US Patent 4,251,921. 24 Feb 1981. Filed date 26 Jul 1979. vp.

The disclosure relates to a tool for borehole logging comprising a plurality of extendable caliper arms to determine borehole contour.

30302 **Preliminary evaluation of geothermal potential of San Juan Basin, New Mexico, using bottom hole temperatures from oil and gas wells.** Chaturvedi, L.; Lory, J.K. (New Mexico State Univ., Las Cruces). *Transactions - Geothermal Resources Council ;* **4**: 21-24(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Bottom hole temperatures from existing well logs of 12,300 oil and gas wells in San Juan Basin, New Mexico were collected and analyzed to evaluate the geothermal potential of this region. The data was used to calculate an approximate geothermal gradient at each well location by assuming a surface temperature of 15°C. The average gradient for the basin, computed from the entire data is 27°C/km. The highest concentration of high computed gradients (> 50°C/km) is in the northwest corner of the state, near Shiprock. Several other locations scattered throughout the basin appear to have promising geothermal potential.

30303 **Airborne electromagnetic surveys as a reconnaissance technique for geothermal exploration.** Christopherson, K.R.; Long, C.L.; Hoover, D.B. (Geological Survey, Denver, CO). *Transactions - Geothermal Resources Council ;* **4**: 29-31(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

INPUT airborne electromagnetic (AEM) surveys were conducted during 1979 in five Known Geothermal Resource Areas (KGRA's). AEM work has not been significantly utilized in the past for geothermal purposes because it was thought that a shallow exploration technique would not be effective. Extensive audio-magnetotelluric (AMT) work by the USGS in KGRA's showed that many geothermal systems do have a near-surface electrical signature which should be detectable by an AEM system. INPUT responses in the form of nested electromagnetic (EM) profiles and channel ratio maps defined the same conductive zones mapped by AMT in five KGRA's, showing that AEM methods can be useful in exploration for and defining geothermal systems.

30304 **Preliminary report on the geothermal resource potential of Nebraska.** Gosnold, W.D. (Univ. of Nebraska, Omaha). *Transactions - Geothermal Resources Council ;* **4**: 45-48(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Preliminary results of the geothermal resource assessment of Nebraska indicate that about 74% of the state overlies regions having temperatures of at least 40°C at a depth of one kilometer. In regions covering about 67% of the state the 40°C isotherm lies within the sedimentary section at depths of about one kilometer and intersects aquifers which are considered potential geothermal resources. A zone of anomalously high geothermal gradients in South Dakota appears to extend into northeastern Nebraska and is evidently due to warm water in the Dakota formation. The preliminary results of heat flow determinations within the state indicate that heat flow in western Nebraska may be as high as 2.0 HFU (83.6 mw/m^2).

30305 **Summary of results of a geological and geophysical investigation of the geothermal energy potential of the Pilgram Springs KGRA, Alaska.** Turner, D.L. (Univ. of Alaska, Fairbanks); Forbes, R.B.; Wescott, E.M. Contract FC07-79ET27034. *Transactions - Geothermal Resources Council ;* **4**: 93-95(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Reconnaissance-level geologic and geophysical studies indicate that the Pilgram Springs, Alaska, area is underlain by an intermediate-temperature, liquid-dominated geothermal system of sub-

stantial magnitude. Initial exploratory drilling has confirmed the presence of the shallow, ≈ 1 to 1.5 km² hot water reservoir delineated by our geophysical surveys. Large artesian flow rates of 200 and 300 to 400 gallons/minute of 90°C water indicate that at least one good aquifer is present at shallow depths within this reservoir. Resistivity surveys suggest that the reservoir is approximately 50 m thick. Deeper hot water reservoirs may also be contained in the thick sedimentary section identified by seismic and gravity surveys, but they have not as yet been located by our initial resistivity surveys. The power presently being dissipated from the upper 50 m of the system is a minimum of 350 megawatts.

30306 **Trace element geochemical zoning in the Roosevelt Hot Springs thermal area, Utah.** Christensen, O.D.; Moore, J.N.; Capuano, R.M. (Univ. of Utah Research Inst., Salt Lake City). Contract AC07-80ID12079. *Transactions - Geothermal Resources Council ;* **4**: 149-152(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Chemical interaction of thermal brines with reservoir rock in the Roosevelt Hot Springs thermal area has resulted in the development of distinctive trace element signatures. Geochemical analysis of soil samples, shallow temperature-gradient drill hole cuttings and deep drill hole cuttings provides a three-dimensional perspective of trace element distributions within the system. Distributions of As, Hg and Li provide the clearest expression of hydrothermal activity. Comparison of these distributions suggests that Li, followed by As and Hg, are progressively deposited by outward flowing, cooling, thermal fluids. Hg, in contrast to As and Li, is distributed only within the outer portions of the thermal system where temperatures are less than about 225°C. Heating experiments indicate that extensive Hg remobilization in Roosevelt samples occurs at temperatures as low as 200° to 250°C. This suggests that the distribution of Hg largely reflects the present system thermal configuration and that this distribution may be a useful soild geothermometer.

30307 **Geochemical investigations at Edgemont, South Dakota.** Knirsch, K.F.; Carda, D.D. (South Dakota School of Mines and Technology, Rapid City). *Transactions - Geothermal Resources Council ;* **4**: 165-168(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Average temperature-depth gradients in wells penetrating the Mississippian Madison Limestone in Edgemont, South Dakota, are 4.7°C/100 m, whereas the average gradient in the Black Hills area is 2.6°C/100 m. Chemical analyses of ground water from forty-one Madison wells and springs were obtained to define the geochemical characteristics of the low-temperature (< 60°C) geothermal system. The results of these analyses show that ground water from wells with high temperature-depth gradients is a sodium chloride-calcium sulfate type, and has concentrations of silica, lithium, and cobalt which are significantly higher than those which are found in all other waters sampled.

30308 **Water geochemistry at Castle Hot Springs, Arizona.** Satkin, R.L.; Wohletz, K.H.; Sheridan, M.F. (Arizona State Univ., Tempe). Contract FI07-79ID12009. *Transactions - Geothermal Resources Council ;* **4**: 177-180(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

A geochemical survey of springs and wells in the Castle Hot Springs area, Arizona, shows that three groups of waters can be distinguished by salinity and chemistry. The thermal waters of Group I range from 640 to 820 ppM TDS, and the waters contain high concentrations of SiO_2, Li^+, and F^-. The non-thermal waters of Group II range from 380 to 580 μpM TDS and contain low concentrations of SiO_2, Li^+, and F^-. The non-thermal waters of Group III range from 1600 to 1650 ppM TDS and contain the highest concentrations of Li^+, Cl^-, and SO_4/sup =/. The discrepancy between the low measured surface temperature at Castle Hot Springs, and the high temperature estimated from chemical geothermometry suggest thermal waters may have cooled either by conduction, boiling or mixing. The chalcedony mixing model yields a reservoir temperature of 95°C and a cold water fraction of 56%.

30309 **Water and gas chemistry from HGP-A geothermal well: January 1980 flow test.** Thomas, D.M. (Hawaii Inst. of Geophysics, Honolulu). *Transactions - Geothermal Resources Council ;* **4**: 181-184(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

A two-week production test was conducted on the geothermal well HGP-A. Brine chemistry indicates that approximately six percent of the well fluids are presently derived from seawater and that this fraction will probably increase during continued production. Reservoir production is indicated to be from two chemically distinct aquifers: one having relatively high salinity and low production and the other having lower salinity and producing the bulk of the discharge.

30310 **Geochemistry at Momotombo, Nicaragua: one aspect in a geothermal field case history.** Tonani, F.B. (Geochemex, Orinda, CA); Teilman, M.A. Contract RA07-79ET27077. *Transactions - Geothermal Resources Council ;* **4**: 193-196(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The Momotombo area was chosen for geothermal development after a number of sites were investigated in western Nicaragua. Geothermometry from several springs at Momotombo indicated subsurface temperatures might range from 153° to 200°C. The geothermometers in subsequent deep exploration wells and measured temperatures were much higher, suggesting the surface thermal waters re-equilibrated with the near-surface environment. Preliminary interpretation of some 1979 flow test data shows a change in the flow regime of some wells. Other subtle changes such as correlated variations between SiO_2 and K or salinity and Mg shifts, could result from a change in flow among producing horizons. Geochemical temperatures based on the recent data ranged from 210° to 324°C. The Na-K, Ca-Na, Ca-K geothermometers were used and seem adequate for monitoring the field. Comparison of the boron content in liquid and steam phases allowed estimates to be made of water-steam separation temperatures in those wells where a change in flow regime occurred. The main body of data is given in a synoptic table.

30311 **Correlation of silica heat flow and temperature gradients, central and western New York.** Hilfiker, K. (SUNY/Buffalo, Amherst, NY); Hanley, C.; Hodge, D.; Morgan, P.; Maxwell, J.; Swanberg, C. *Transactions - Geothermal Resources Council ;* **4**: 209-212(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The correlation between chemical geothermometers and temperature gradients from bottom-hole temperatures in central and western New York indicates that the silica heat flow interpretation technique is useful in detecting areas of elevated heat flow but the method may not always be able to precisely locate the anomalous zone. A revised geothermal gradient map that corrects for transient thermal disturbances due to drilling shows three distinct geothermal anomalies near East Aurora, Cayuga and Elmira, NY. Gradients over the entire area range from 24°C/km to about 36°C/km over these anomalies. A silica heat flow map has been contoured from a data set of over 500 values and shows a good correlation with the temperature gradient map for the Cayuga anomaly. The East Aurora and Elmira anomalies are not distinctly defined by the silica heat flow.

30312 **Seismic refraction and gravity surveys of Pilgrim Springs KGRA, Alaska.** Lockhart, A.; Kienle J. (Univ. of Alaska, Fairbanks). Contract FC07-79ET27034. *Transactions - Geothermal Resources Council ;* **4**: 213-216(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Pilgrim Springs KGRA is located in a major northeast-trending tectonic depression on the Seward Peninsula, Alaska. Refraction has identified a layer which coincides with a hot artesian aquifer in hydrothermally cemented sediments. The presence of a hydrothermal cap rock is possible but not proven. Crystalline bedrock lies at least 200 m beneath the springs, dropping to possibly

500 m in depth immediately to the southwest in what appears to be a trough bounded by normal faults on the north, south and east. Pilgrim Springs are situated over the intersection of the two faults at the northeastern corner of this trough, suggesting that one or both faults are acting as conduits to the springs. Pilgrim Springs are associated with extensional tectonics and recent alkalic volcanism suggestive of active rifting in the region.

30313 **Summary of the geology and geophysics of the San Emidio KGRA, Washoe County, Nevada.** Mackelprang, C.E.; Moore, J.N.; Ross, H.P. (Univ. of Utah Research Inst., Salt Lake City). Contract AC07-80ID12079. *Transactions - Geothermal Resources Council ;* **4**: 221-224(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Geologic mapping, thermal gradient drilling, electrical resistivity surveys, and gravity data interpretation define a north-trending Basin and Range fault which acts as the principle conduit for hydrothermal fluids at San Emidio. There is a possibility that this principle conduit has not been intersected in the drilling to date. The maximum temperature recorded to date is 262°F. The low apparent reservoir temperatures have reduced interest in exploration for an electrical power quality resource. An economic evaluation for using the hydrothermal fluids in industrial processing is now underway.

30314 **Geothermal exploration at the Tuscarora prospect in Elko County, Nevada.** Pilkington, H.D.; Lange, A.L.; Berkman, F.E. (AMAX Exploration, Inc., Wheat Ridge, CO). Contract AC08-79ET27011. *Transactions - Geothermal Resources Council ;* **4**: 233-236(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The Tuscarora prospect was discovered in 1977 at the north end of Independence Valley approximately 90 kilometers north-northwest of Elko, Nevada. Independence Valley is a fault basin on the west side of Independence Range in the area where the Basin and Range structure abut with the Snake River downwarp. Geothermal manifestations include over twenty-five thermal springs which issue along a 4.8 kilometer linear zone trending north-northeast. A siliceous sinter deposit is present for about 1.6 kilometers along the zone. Water chemistry using a mixing model indicates a minimum subsurface temperature of 216°C.

30315 **Hueco tanks: an initial evaluation of a potential geothermal area near El Paso, Texas.** Taylor, B.; Roy, R.F.; Hoffer, J.M. (Univ. of Texas, El Paso). *Transactions - Geothermal Resources Council ;* **4**: 253-256(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

A potential geothermal resource about 40km northeast of El Paso, Texas is under investigation. The presence of old hot wells indicated the area of interest, and a geochemical survey outlined the possible geothermal anomaly. A shallow drilling program has revealed gradients consistently over 100°C/km and as high as 300°C/km on the Texas side of the state line, and a 300m hole yielded a heat flow of 8.3 H.F.U. in the limestone bedrock. Electrical soundings have shown the presence of a shallow conductive layer (probably hot and/or mineralized water) and a recently completed gravity survey delineates the faulting pattern apparently responsbile for the uprise of thermal waters. Indications are presently not for an electricity-grade resource, but of a hot water reservoir, with temperatures maybe reaching 120 to 140°C.

30316 **Electrical resistivity survey of the Pilgrim Springs geothermal area, Alaska.** Wescott, E.; Sydora, R.; Peace, J.; Lockhart, A. (Univ. of Alaska, Fairbanks). Contract FC07-79ET27034. *Transactions - Geothermal Resources Council ;* **4**: 257-259(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Pilgrim Springs is located on the Seward Peninsula about 50 miles north of Nome, Alaska. A case history of the use of electrical resistivity to delineate a geothermal reservoir and for drilling recommendations is presented. Pilgrim Springs water, being saline, has an electrical resistivity value of 1 Ω-m, providing an ideal contrast for resistivity definition of the reservoir. In 1979 several deep Schlumberger and co-linear dipole-dipole surveys were run in and near the 1.5 km² thaw window. The results suggest that there is a pancake-shaped reservoir near the surface, approximately 50 m thick, which has the shape of the thaw window but is thicker and deeper to the north under the Pilgrim river. The conduit is suspected to be a small feature which is difficult to find under the near-surface, low-resistivity reservoir.

30317 **Upgrading the acoustic borehole televiewer for geothermal fracture mapping.** Heard, F.E. (Sandia National Labs., Albuquerque, NM). Contract AC04-76DP00789. *Transactions - Geothermal Resources Council ;* **4**: 341-344(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The importance of fracture characterization in geothermal logging has long been recognized. The acoustic borehole televiewer is probably the single most useful tool for determining location, orientation, and characterization of fractures. However, since the televiewer was developed for low temperature oil and gas exploration, it has not been capable of reliable operation at geothermal temperatures. The theory of operation of the acoustic televiewer, the problems associated with its operation at both high and low temperatures, and a program to upgrade the tool are reviewed. Major results of the program have been: (1) a high temperature acoustic transducer, (2) an improved acoustic window, (3) more reliable electronics, and (4) the elimination of troublesome slip rings.

30318 **Upgrading Amerada-type survey clocks for high-temperature geothermal service.** Major, B.H.; Witten, C.L. (Sandia National Labs., Albuquerque, NM). *Transactions - Geothermal Resources Council ;* **4**: 361-264(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The Amerada type subsurface recording gauges have been used by the oil and gas industry for many years. These mechanical logging instruments are currently used by the growing goethermal industry. As the gauges were designed for service in low-temperature oil and gas wells, a significant number of failures are occurring at elevated geothermal temperatures. The spring driven mechanical survey clocks appear to be the primary cause of the failures. The clock mechanisms tend to stop or lock-up when exposed to temperatures as high as 300°C. This paper summarizes a project that was undertaken to upgrade the survey clocks to 300°C capability. The major problems causing clock failure were indentified and corrected by straightforward design modifications together with special lubrication of the moving parts. Several clocks so modified performed reliably, both during laboratory oven tests and during field tests that were performed in actual geothermal wells at temperatures up to 330°C.

30319 **Temperature dependence of permeability.** Gobran, B.D.; Brigham, W.E.; Sanyal, S.K. (Stanford Univ., CA). *Transactions - Geothermal Resources Council ;* **4**: 397-400(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Permeability is an important reservoir parameter affecting the production of fluids from and the injection into reservoirs. This work indicates that permeability of a reservoir rock is a function of temperature. Since permeability is normally measured at room conditions, laboratory estimates could deviate greatly from actual reservoir conditions. Use of such erroneous data may cause large errors in reservoir simulation or production forecast. The absolute permeability of confined Ottawa sand to water has been measured as a function of temperature. To minimize assumptions, the density-viscosity ratio of the core efflux is measured and used in the calculation of permeability. An analysis of the errors inherent in these measurements is incorporated in each calculation and this shows that the observed non-reversible permeability reduction with temperature increase is significantly greater than the experimental error.

30320 Geophysical investigations at Momotombo, Nicaragua. Cordon, U.J.; Zurflueh, E.G. (International Engineering Co., Inc., San Francisco, CA). Contract RA07-79ET27077. *Transactions - Geothermal Resources Council ;* **4**: 447-450(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The Momotombo geothermal field in Nicaragua was investigated in three exploration stages, using a number of geophysical techniques. Stage 1 of the investigations by Texas Instruments, Inc., (1970) located and delineated a potential geothermal field, with the dipole mapping surveys and electromagnetic soundings being most effective. Stage 2 of the investigations, performed in 1973 by the United Nations Development Program (UNDP), outlined the resistivity anomalies in the area west of the previously selected field; Schlumberger VES soundings and constant depth profiling (SCDP) proved most useful. During Stage 3 of the investigations, Electroconsult (ELC) performed 20 additional Schlumberger VES soundings as part of the 1975 plant feasibility studies. Results of these geophysical techniques are summarized and their effectiveness briefly discussed.

30321 Rn and Hg surveys: geothermal exploration in N.E., Maui, Hawaii. Cox, M.E.; Cuff, K.E. (Univ. of Hawaii, Honolulu). Contract AS07-78ID01713. *Transactions - Geothermal Resources Council ;* **4**: 451-454(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Regional assessment for geothermal potential in Hawaii indicated thermal alteration of shallow groundwater in northeast Maui. Studies within the area, the lower north rift of Haleakala volcano, include the measurement of ground Rn emanation, soil Hg concentration and soil pH. Anomalous results from these geochemical techniques are reasonably coincident, and are located over the western boundary of the rift structure. These studies suggest anomalous subsurface temperatures associated with the rift and consequent enhancement of ground gas outgassing. Further surveys, both geochemical and geophysical, are currently being carried out to confirm these conclusions.

30322 Well-site evaluation of logs from a geothermal well. Sanyal, S.K. (Stanford Univ., CA); Gardner, M.; Koenig, J.B.; McIntyre, J. *Transactions - Geothermal Resources Council ;* **4**: 471-474(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The case history of a well-site analysis of a suite of logs from a moderate temperature (350°F) geothermal well is presented. From logs and drill cuttings data, a set of diagnostic criteria for each of the lithologic types in the well was developed. From these criteria a lithologic zonation of the reservoir was derived. Using a set of fracture detection criteria based on all availiable well logs, the probability of occurrence of fractures at various depths was qualitatively evaluated. Although the mud log showed significant methane concentration, the detection and estimation of reservoir gas content from well logs was not successful because of data limitation. The equilibrium formation temperature was estimated from logs but is not discussed in detail.

30323 Computer analysis of a limited well log suite in a geothermal well: a case history. Sanyal, S.K. (Stanford Univ., CA); Wells, L.E.; Cleneay, C.; Mathews, M. *Transactions - Geothermal Resources Council ;* **4**: 475-478(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The case history of analysis of a limited logging suite (density, sonic, gamma ray, caliper and temperature) from a geothermal well with a complex mixture of sedimentary and igneous lithologies is presented. The drill cuttings description listed at least nineteen lithologic types. Starting with the drill cutting description and digitized log data, a detailed lithologic zonation of the well was achieved by systematic analysis of the clustering of data points on crossplots. Because of the large number of lithologic types and a limited logging suite, quantitative estimates of the various lithologic components and porosity could not be obtained. However by comparing all log responses and lost circulation data, the porous zones could be identified. An estimate of mechanical strength of various zones from density and sonic logs correlated well with caliper log and physical characteristics expected of various lithologies.

1504 Legal And Institutional Aspects

30324 (DOE/SF/10854—T1) Measurement of attitudes toward commercial development of geothermal energy in Federal Region IX. Final report. (Market Facts, Inc., Arlington, VA (USA)). Jun 1981. Contract AC03-80SF10854. 559p. NTIS, PC A24/MF A01. Order Number DE81028442.

A survey was conducted of ten target study groups and subgroups for Klamath Falls, Oregon, and Susanville, California: local government, current and potential industry at the site, relocators to the site, current and potential financial community, regulators, and current and potential promoters and developers. The results of benchmark attitudinal measurement is presented separately for each target group. A literature review was conducted and Macro-environmental attitudes of a sample of local government and industry personnel at the sites were assessed. An assessment of capabilities was made which involved two measurements. The first was a measurement of a sample of promoters, developers, and industrial service companies active at the site to determine infrastructure capabilities required by industry for geothermal plants. The second measurement involved analyzing a sample of industry management in the area and defining their requirements for plant retrofit and expansion. Finally, the processes used by the study group to analyze information to reach commitment and regulatory decisions that significantly impact on geothermal energy projects at the site were identified and defined.

30325 Grand scheme for the geothermal industry in the Imperial Valley. Vetter, O.J. (Vetter Research, Costa Mesa, CA); Nicholson, R.W. Contract AC03-79ET27146. *Transactions - Geothermal Resources Council ;* **4**: 695-698(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The geothermal industry is confronted with a number of technical, economical, environmental and political problems. A scenario for solving most of these problems is described. It is the opinion that treating only one kind of problem should not be attempted without considering each problem as an integral part of an entire geothermal project. An over-all concept to attack and/or solve most pertinent problems as a whole is described. A piece-meal approach to attack various problems individually and out of context will cause further delays and economic hardship during the development of geothermal resources within the United States.

30326 Status of DOE's international cooperative efforts in geothermal energy. Metzler, J.E. (Dept. of Energy, Washington, DC). *Transactions - Geothermal Resources Council ;* **4**: 811-813(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The US Department of Energy is involved with bilateral arrangements with Italy, Mexico, New Zealand and Japan, and in three multilateral International Energy Agency Agreements. These activities provide each participant technical benefit, and serve to accelerate the introduction of geothermal energy utilization worldwide as well as serving foreign policy objectives. The chief benefit to the Department of Energy has probably been to its reservoir modelling efforts, which have been improved and evaluated by employing the data and case histories provided by various countries.

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 30410

30327 (LBL—11133) Price estimates of hot-water geothermal energy. Howard, J.H. (Lawrence Berkeley Lab., CA (USA)). Feb 1981. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01. Order Number DE81028910.

A generalized price equation for hot water geothermal energy has been developed. The equation is based on analysis of

proposed plans for use of geothermal energy to displace specific quantities of fossil fuels. The equation is useful in starting negotiations for sale of heat from a hot water resource and is necessary in any reserve valuation in the absence of a firm sales contract. The sales price of the only known hot water geothermal energy sales contract is presently 0.082 mills/1bm and compares with 0.079 mills/1bm according to the proposed equation.

30328 **Extraction timing and economic incentives for geothermal reservoir management.** Golabi, K. (Woodward-Clyde Consultants, San Francisco, CA); Scherer, C.R. Contract E476-S-03-0034PA248. *Journal of Environmental Economics and Management ;* **8**: No. 2, 156-174(Jun 1981).

This article considers the best extraction program for a hot-water geothermal reservoir with emphasis on the optimal time to begin extraction. Using a production function relating the rate of extraction to the quality of produced energy, an operational model is presented that gives the best time to begin production, the optimal pumping rate, and the best planning horizon. Also investigated is the effect of economic parameters and incentives on these decision variables. This paper studies some means by which regulatory agencies can influence the timing and rate of exploitation of geothermal energy by manipulating economic incentives, and provides information for both public and private decision making in the management of this resource. 11 references, 3 figures, 2 tables.

30329 **Geothermal Loan Guaranty Program: recommendations for improvement including new simplified application procedures for small projects.** Meyer, R.T.; Coe, B.A.; Nasr, L.H.; Bixler, M. (Western Energy Planners, Ltd., Denver, CO). *Transactions - Geothermal Resources Council ;* **4**: 751-753(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The Geothermal Loan Guaranty Program was established by Congress in 1974 to assist industry with the financing requirements for the development and commercialization of geothermal energy. It was the only substantive federal aid program to an emerging technology at that time. Yet in six years (as of April 1980) only four projects have been approved for a loan guaranty, three of which are electric projects and one is a small direct thermal application. Many small business/small project energy producers, developers, and users have found or concluded that they cannot qualify for a geothermal loan guaranty. This paper reports the results and recommendations of a comprehensive evaluation of the GLGP from the perspective of the small business/small project entrepreneur and from the practices of the small to medium size lending institutions. The findings are divided into administrative, regulatory and legislative recommendations.

30330 **Alternate energy investment decision modelling: the case of geopressured-geothermal investment decisions.** Prestwood, D.C.L.; Duffy, J.M.; Stone, M.; Vanston, J.H. Jr. (Univ. of Texas, Austin). *Transactions - Geothermal Resources Council ;* **4**: 755-757(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

This decision modelling project utilizes multiattribute utility theory to capture both the economic and non-economic criteria potential geopressured-geothermal resource developers utilize to reach a decision to participate, or not, in a venture such as geopressured-geothermal development. Knowledge from this work will be utilized in conjunction with a geopressured-geothermal economic model to determine effects of various incentive schemes proposed to expedite the development of the geopressured-geothermal resource along the Texas-Louisiana Gulf Coast.

1506 Environmental Aspects And Waste Disposal

30331 **(DOE/ET/28443—T11) SDG and E/ERDA Geothermal Loop Experimental Facility. Brine reinjection pump report.** Bishop, H.K; Bricarello, J.R.; Enos, F.L.; Hodgdon, N.C.; Jacobson, W.O.; Li, K.K.; Lombard, G.L.; Mulliner, D.K.; Swanson, C.R. (Cornell Univ., Ithaca, NY (USA)). Jan 1977. Contract AC03-76ET28443. 62p. NTIS, PC A04/MF A01. Order Number DE81024241.

The physical description of the pump and its history of operation and maintenance from May through December, 1976 are presented. A detailed discussion of modifications made to the pump is included. Summaries regarding the compatibility of the pump with the GLEF operation are included. (MHR)

30332 **(LBL—11271) Geothermal-subsidence research program plan and review.** Goldstein, N.E.; Noble, J.E.; Simkin, T.L. (Lawrence Berkeley Lab., CA (USA)). Sep 1980. Contract W-7405-ENG-48. 49p. NTIS, PC A03/MF A01. Order Number DE81028551.

The revised Geothermal Subsidence Research Plan (GSRP) presented here is the result of two years of research based on the recommendations of a technical advisory committee and on the DOE/DGE's wish to include specific components applicable to the geopressure resources on the Gulf Coast. This revised plan describes events leading up to FY 1979 and 1980 and the resulting research activities completed for that period. At the time of this writing most of the projects are completed; this document summarizes the accomplishments of the GSRP during FY 1979 and 1980 and includes recommendations for the FY 1981 and 1982 programs.

30333 **Final environmental impact report. Part I. Pacific Gas and Electric Company Geysers Unit 16, Geothermal Power Plant, Lake County, California.** Sacramento, CA; California Energy Commission (1981). 363p. (NP—1903673).

The environmental analysis includes the following: geology, soils, hydrology, water quality, vegetation, wildlife, air resources, health and safety, noise, waste management, cultural resources, land use, aesthetics, socioeconomics, public services, transportation, and energy and material resources. Also included are: the project description, a summary of environmental consequences, and alternatives to the proposed action. (MHR)

30334 **Final environmental impact report. Part II. Pacific Gas and Electric Company Geysers 16 to Lakeville transmission line and Lakeville to Sobrante transmission line.** Chavez, D. Sacramento, CA; California Energy Commission (1981). 439p. (NP—1903670).

The purpose of this Environmental Impact Report (EIR) is to provide the general public and the decision makers with information concerning the significant environmental effects of the projects, the manner in which significant effects of the projects may be mitigated, and any feasible alternatives to the projects. A significant effect on the environment means a substantial or potentially substantial adverse change in the environment. The sections of the EIR discuss the projects as proposed by PG and E, and the environmental analysis of the projects. Sections on the natural and social environments of the proposed projects and their surrounding areas consist of descriptions of the setting, discussions of the adverse and beneficial consequences of the project, and potential mitigation measures to reduce the effects of adverse impacts. The EIR includes discussions of unavoidable adverse effects, irreversible changes, long-term and cumulative impacts, growth-inducing effects, and feasible alternatives to the project. The significant impacts resulting from the construction and operation of the three transmission lines are the loss of vegetation, disturbance to archaeological and historic resources, and visual intrusion. The spare transmission capacity of the proposed Castle Rock to Lakeville and Lakeville to Sobrante lines will accommodate the power produced by approximately 12 additional 110 MW geothermal power plants in The Geysers KGRA without the need for additional major transmission lines. Such additional development would contribute significantly to the cumulative impacts.

30335 **Raft River geothermal site: a reinjection study.** Ahmed, U.; Wolgemuth, K.M.; Abou-Sayed, A.S.; Schatz, J.F.; Jones, A.H. (Terra Tek, Inc., Salt Lake City, UT). Contract AC07-77ET29301. *Transactions - Geothermal Resources Council ;* **4**: 385-388(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Analysis of transient pressure tests combined with spinner surveys and a knowledge of the geology of the area have allowed us to define the injectivity potential of the Raft River geothermal

site. The present two injection wells will allow approximately two to four months of injection at the required rate of 2500 gpm without fracturing the formation. A numerical simulator has been used to model the injection portion of the reservoir to investigate options such as hydraulic fracturing or the drilling of an additional well to provide sufficient subsurface disposal.

30336 **Fracture acidization study of calcareous siltstone from a geothermal reservoir.** Wolgemuth, K.M.; Abou-Sayed, A.S.; Ahmed, U.; Schatz, J.F.; Jones, A.H. (Terra Tek, Inc., Salt Lake City, UT). Contract AC07-77ET28301. *Transactions - Geothermal Resources Council ;* 4: 431-433(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Laboratory tests have been performed to evaluate the effects of hydrochloric and acetic acids on fracture conductivity at in situ conditions. This work was done on core samples of calcereous siltstone from the Salt Lake Formation (the injection horizon) at the Raft River geothermal area to assess whether an acid hydraulic fracture would improve injectivity. Acid treatment resulted in reduced fracture conductivity caused by partial dissolution of the calcite matrix and the subsequent closure of the fracture.

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 30349, 30409

30337 **(DOE/ET/28443—T13) 1974 geothermal field tests at the Niland Reservoir in the Imperial Valley of California.** (San Diego Gas and Electric Co., CA (USA)). 1974. Contract AC03-76ET28443. 156p. NTIS, PC A08/MF A01. Order Number DE81026446.

The phases of the 1974 geothermal field tests at the Niland Reservoir in the Imperial Valley of California are documented. The following tests are included: separator, steam scrubber, steam turbine, heat exchanger, packed heat exchanger, corrosion, chemical cleaning, and control and instrumentation. (MHR)

30338 **(EGG-GTH—5456) Condensing curves for a number of mixed-hydrocarbon working fluids.** Denmuth, O.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Jul 1981. Contract AC07-76ID01570. 37p. NTIS, PC A03/MF A01. Order Number DE81028654.

Condensing curves are presented for a number of two-component mixed hydrocarbon working fluids which are potentially usable in binary geothermal cycles. Performance of geothermal thermodynamic cycles incorporating these fluids has been evaluated under separate cover; two figures summarizing the results of those evaluations have been included here for continuity. The purpose of this report is: first, to document the condensing curves which were used in the mixed fluid cycle analyses, and second, to provide background useful in the preliminary evaluation of heat rejection systems for advanced geothermal electric power plants utilizing mixed hydrocarbon working fluids. Some concluding remarks are presented.

30339 **(EGG-M—03281) Raft River geothermal facility.** Whitbeck, J.F. (Idaho National Engineering Lab., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 7p. (CONF-8106135—1). NTIS, PC A02/MF A01. Order Number DE81028276.

From 5. annual EPRI geothermal conference; San Diego, CA, USA (22 Jun 1981).

An update on the power conversion activities at the 5MW(e) pilot plant, the 60kW(e) binary system, and the water treatment laboratory located at the Raft River Facility is presented.

30340 **(ORNL/TM—7797) Condensation of Refrigerant-11 on the outside of vertical enhanced tubes.** Domingo, N. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 90p. NTIS, PC A05/MF A01. Order Number DE81026085.

Experiments were conducted to determine heat transfer performance of single vertical tubes with Refrigerant-11 condensing on its outside surface. Twelve enhanced (fluted, spiraled, roped, and corrugated) tubes of 2.54-cm (1-in.) nominal outside diameter and 1.2-m (4-ft) length were tested. Several of the tested tubes featured internal enhanced geometries. A previously tested smooth tube served as the basis for comparison. Composite heat transfer coefficients (coefficients that include the resistances of both the condensing film and the tube wall), based on the total tube outside surface area, ranged from 850 to 6530 $W/m^2 . K$ (150 to 1150 $Btu/h . ft^2 . °F$) over the heat flux range of 5675 to 31,375 W/m^2 (1800 to 9950 $Btu/h . ft^2$). The primary conclusions from this study are: (1) for a given heat flux, an external fluted tube can increase composite condensing heat transfer coefficients by up to 5.5 times the smooth tube values, giving better condensing performance than any of the other geometries tested; (2) further increase in composite condensing coefficients can be achieved by using skirts to divide the fluted tube into equal condensing lengths; and (3) for a given overall temperature difference and water flow rate, internal flutes can increase the overall performance by up to 17% over that for a tube with identical outside flutes and a smooth inside surface.

30341 **Progress report on HGP-A wellhead generator feasibility project.** Chen, B.H. (Univ. of Hawaii, Honolulu); Lopez, L.P.; Kuwada, J.T.; Farrington, R.J. Contract AC03-78ET28420. *Transactions - Geothermal Resources Council ;* 4: 491-494(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The HGP-A Well underwent a substantial workover last fall. A new tie-back 7" casing was installed from surface to 3000 ft. A two-week test was conducted in January, 1980, with full hydrogen sulfide and noise abatement. Preliminary test results showed a slight increase in total mass flow. Both noise and odor abatement were shown to be very effective. As a result of the two week test, some changes have been made to the final design, and the projected plant on-line date has been extended to March 31, 1980.

30342 **Assessment of geothermal energy as a power source for US aluminum reduction plants.** Davis, A.E.; Enderlin, W.I.; Balhnik, D.E.; Jacobson, J.J.; Weakley, S.A. (Battelle Pacific Northwest Lab., Richland, WA). *Transactions - Geothermal Resources Council ;* 4: 495-498(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The technical and economic feasibility of using geothermal resources as a primary power source for US aluminum reduction plants was assessed. The principal objective was to explore the potential for providing geothermally generated electric power to existing smelters in the Pacific Northwest. Also evaluated were the possibiities of supplying existing smelters in the Gulf Coast area, as well as supplying new smelters located at or near a geothermal resource. While not conclusive, the study results strongly suggest that it is both technically and economically feasible to power an existing smelter in the Northwest using electricity generated at Roosevelt Hot Springs, Utah. It was therefore concluded that detailed, site-specific feasibility studies are justified and should be undertaken. Further, it was concluded that it would not generally be feasible to operate either existing Gulf Coast smelters or newly constructed smelters using geothermal electric power.

30343 **Baca Data Dissemination Program.** Sherwood, P.B.; Marquis, M.A. *Transactions - Geothermal Resources Council ;* 4: 531-532(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Under the Baca Geothermal Demonstration Power Plant Cooperative Agreement, large amounts of data are to be organized and disseminated to the public. The purpose of the Baca Data Dissemination Program is to link the project data sources to a potentially broad spectrum of information users. Major sources of project data include the power plant, the production system, and all associated geological, geophysical, subsurface, environmental, legal and financial data. Potential users of these data primarily include industrial organizations such as utilities, resource developers, architect-engineering firms, and financial institutions. An Information Dessemination Plan is presently in preparation which will define the link between project data sources and potential information users.

30344 **Geothermal application of heat exchanger design for desalination plants.** Fritzler, E.A.; Coury, G.E. (Coury and Associates, Inc., Lakewood, CO). *Transactions - Geothermal Resources Council ;* **4**: 561-564(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Heat exchangers can be a very costly part of modern geothermal plants for either electric or direct heat applications. To make maximum use of technology transfer from other industries, and to minimize as much as possible the need to duplicate previous work, this report has been prepared to provide an analytical review of the very extensive literature on heat exchangers developed by the Office of Saline Water (OSW). The OSW accomplished a very large amount of significant work related to the design and performance of large heat exchanger bundles and enhanced heat transfer surfaces. The exchanger design configurations that were studied include multistage flash plant condensers, vertical tube falling film and upward flow evaporators, and horizontal tube spray film evaporators.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 30298, 30337

30345 **(DOE/ET/28443—T9) Niland Test Facility Startup Evaluation Task Force.** (San Diego Gas and Electric Co., CA (USA)). Feb 1976. Contract AC03-76ET28443. 16p. NTIS, PC A02/MF A01. Order Number DE81024345.

Task force recommendations that are considered essential for proper start up of the Niland Test Facility are presented, along with those desirable for start up, but not essential and those desirable during operation but having no direct effect on start up. (MHR)

30346 **(DOE/ET/28443—T10) Niland Test Facility Startup Evaluation Task Force.** (San Diego Gas and Electric Co., CA (USA)). Jan 1976. Contract AC03-76ET28443. 95p. NTIS, PC A05/MF A01. Order Number DE81024342.

The following team reports are included: systems, operation, control, and safety; instrumentation; brine chemistry and materials evaluation; reservoir assessment; environment; and contingency analysis. (MHR)

30347 **(DOE/ET/28443—T12) Geothermal loop experimental facility. Quarterly project report, April 1, 1976-June 30, 1976.** (San Diego Gas and Electric Co., CA (USA)). 28 Jun 1976. Contract AC03-76ET28443. 11p. NTIS, PC A02/MF A01. Order Number DE81024240.

Operations with the Geothermal Loop Experimental Facility are reviewed. Inspection of the separators, scrubbers, pumps, valves, and controls is described. (MHR)

30348 **(DOE/TIC—1027465) Development of bushings and bearings for use in hot-brine pumps. Quarterly technical progress report No. 6, March 1-June 1, 1981.** (Brookhaven National Lab., Upton, NY (USA); Solar Turbines International, San Diego, CA (USA)). 1981. Contract AC02-76CH00016. 26p. NTIS, PC A03/MF A01. Order Number DE81027465.

The nature of the problems associated with premature failures of downhole line shaft bearings, especially those tested in the Imperial Valley, was studied. Problem Definition is complete. Phase II, 100-hour Screening Tests, is 80 percent completed with promising results. Significant testing procedure modifications have been made and are presented.

30349 **(EGG-GTH—5474) Corrosion testing of carbon steel in aereated geothermal brine.** Suciu, D.F.; Wikoff, P.M. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1981. Contract AC07-76ID01570. 55p. NTIS, PC A04/MF A01. Order Number DE81028653.

Two major problems are associated with the use of cooled geothermal water as coolant for the 5 MW(e) Pilot Power Plant at Raft River. They are: (1) a scaling potential owing to the chemical species present in solution, and (2) the corrosive nature of the geothermal water on carbon steel. A water treatment test program was established to reduce or eliminate these problems. Data show that scale can be prevented by a combination of dispersants and controlling the concentration of scaling species in the circulating water. Corrosion cannot be controlled without a pretreatment of tubing material. With the pretreatment, a protective gamma iron oxide film is laid down on the tube surface, that with proper corrosion inhibitor additives, significantly reduces both general and pitting corrosion. However, longer term testing is required to determine protection of pitting corrosion.

30350 (SAND—81-0036C, pp 2.1-2.26) **Geothermal drilling in Cerro Prieto.** Dominguez, B.; Sanchez, G. (Comision Federal de Electricidad de Mexico, Calexico, CA). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

To date, 71 goethermal wells have been drilled in Cerro Prieto. The activity has been divided into several stages, and, in each stage, attempts have been made to correct deficiencies that were gradually detected. Some of these problems have been solved; others, such as those pertaining to well casing, cement, and cementing jobs, have persisted. The procedures for well completion - the most important aspect for the success of a well - that were based on conventional oil well criteria have been improved to meet the conditions of the geothermal reservoir. Several technical aspects that have improved should be further optimized, even though the resolutions are considered to be reasonably satisfactory. Particular attention has been given to the development of a high-temperature drilling fluid capable of being used in drilling through lost circulation zones. Conventional oil well drilling techniques have been used except where hole-sloughing is a problem. Sulfonate lignitic mud systems have been used with good results. When temperatures exceed 300°C (572°F), it has been necessary to use an organic polymer to stabilize the mud properties.

30351 (SAND—81-0036C, pp 3.1-3.14) **New Zealand geothermal investigations: drilling into the eighties.** Fooks, E.L.D. (Ministry of Works and Development, Taupo, New Zealand). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Over the past 3 decades, some 243 wells (180 ms [112 mi] have been drilled in various fields within New Zealand to investigate and utilize geothermal energy. This number does not include wells drilled for minor industrial and domestic uses. Drilling and completion techniques have been evolved such that no structural failures or uncontrollable blowouts have occurred with wells drilled in the past 10 years. However, there is still room for further improvement to effect more rapid and economical completion of future wells. Drilling techniques, equipment, and materials currently in use in New Zealand are described, including surface and downhole drilling equipment, drilling fluids, cementing, and casing programs, together with proposed improvements. Recent work, including drilling a deviated well, recementing production casing after the original cementing had failed, cementing a sleeve into a well which had broken casing, removing calcite deposition from a production well, and isolating a cool inflow into a well, thus bringing the well back into production, is also described. Proposals to modify an existing well, enabling separate production from two production horizons, are outlined.

30352 (SAND—81-0036C, pp 4.1-4.10) **Drilling of a 2000 m (6562 ft) borehole for geothermal steam in Iceland.** Ragnars, K.; Benediktsson, S. (Orkustofnun National Energy Authority, Reykjavik, Iceland). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

A description is given of the drilling and well completion of a 2000-metre (6562-foot) borehole drilled with an electrically driven Gardner Denver 700E rig. Such a borehole is typical of wells drilled at the Namafjall and Krafla high-temperature fields, where bottomhole temperatures exceed 300°C (572°F) and a 1000-metre (3281-foot) cemented production casing is required. Factors of importance are the drilling procedure, the blowout equipment, and

the casing and cementing procedure, as well as the well cost. Initial drilling is done with a percussion drill down to approximately 50 metres (164 feet), and loose surface layers are cased off. Rotary drilling starts at this point. The rotary drilling is carried out with 44.5-cm (17-1/2-in.) insert bits down to 300 metres (984 feet), 31.1-cm (12-1/4-in.) bits down to 1000 metres (3281 feet), and 21.6-cm (8-1/2-in.) bits down to 2000 metres (6562 feet). Directional surveying is carried out to assist in keeping the well vertical. The classification of blowout equipment and the design of the casing program depend on the steam pressure. The 34.0-cm (13-3/8-in.) anchor casing is set down to 300 metres (984 feet) and the 24.5-cm (9-5/8-in.) production casing down to 600 to 1000 metres (1969 to 3281 feet) to seal off aquifers in the upper section as necessary. A 17.8-cm (7-in.) slotted liner is hung from the lower end of the production casing down to the bottom. The main difficulty in cementing the casing is the loss of circulation, which requires a stage cementing collar and perforation of the casing. The total cost of the well described was approximately 1 million US dollars in 1980.

30353 (SAND—81-0036C, pp 8.1-8.26) **Geothermal well costs and their sensitivities to changes in drilling and completion operations.** Carson, C.C.; Lin, Y.T. (Sandia National Lab., Albuquerque, NM). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

A detailed analysis of the costs of drilling and completing geothermal wells is presented. The basis for much of the analysis is a computer-simulation-based model which calculates and accrues operational costs involved in drilling and completing a well. Geothermal well cost are discussed in general, with special emphasis on variations among different geothermal areas in the United States, effects of escalation and inflation over the past few years, and comparisons of geothermal drilling costs with those for oil and gas wells. Cost differences between wells for direct use of geothermal energy and those for electric generation are also indicated. In addition, a breakdown of total well cost into its components is presented. This provides an understanding of the relative contributions of different operations in drilling and completions. A major portion of the cost in many geothermal wells is from encountered troubles, such as lost circulation, cementing difficulties, and fishing. These trouble costs are considered through both specific examples and statistical treatment of drilling and completions problems. The sensitivities of well costs to variations in several drilling and completion parameters are presented. The model makes it possible to easily vary parameters such as rates of penetration; bit lifetimes; bit, rental, or rig costs; delay times; number of cement plugs; etc. The effects of these variations on different types of geothermal wells are compared.

30354 (SAND—81-0036C, pp 9.1-9.24) **Directional drilling and equipment for hot granite wells.** Williams, R.E. (Los Alamos National Lab., NM); Neudecker, J.W.; Rowley, J.C.; Brittenham, T.L. 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Directional drilling technology was extended and modified to drill the first well of a subsurface geothermal energy extraction system at the Fenton Hill, New Mexico, hot dry rock (HDR) experimental site. Drilling equipment and techniques used in drilling wellbores for extraction of geothermal energy from hot granite were generally similar to those that are standard and common to hydrocarbon drilling practices. However, it was necessary to design some new equipment for this program; some equipment was modified especially for this program and some was operated beyond normal ratings. These tools and procedures met with various degrees of success. Two types of shock subs were developed and tested during this project. However, downhole time was limitsd, and formations were so varied that analysis of the capabilities of these items is not conclusive. Temperature limits of the tools were exceeded. Commercial drilling and fishing jars were improved during the drilling program. Three-cone, tungsten-carbide insert bit performance with downhole motors was limited by rapid gauge wear. Rotary drilling was optimized for wells EE-2 and EE-3 using softer (IADS 635 code) bits and provided a balance between gauge, cutting structure, and bearing life. Problems of extreme drill string drag, drill string twist-off, and corrosion control are discussed.

30355 (SAND—81-0036C, pp 10-1.10-8) **Turbodrilling in the geothermal environment.** Herbert, P. (Sii Dyna-Drill, Irvine, CA). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Geothermal drilling, historically, has presented what seemed to be insurmountable barriers to the efficient and extended use of downhole drilling motors, especially those containing elastomeric bearing or motor components. In addition to being damaging to rubber, the typical temperatures of 177° to 371°C (350° to 700°F) create other operating problems as well. Recent innovations, specifically in turbodrill design, have opened heretofore unrealized potentials and allowed, for the first time, extended downhole drilling of geothermal wells. A considerable amount of experience has been obtained both in The Geysers and Imperial County areas of California primarily in directional drilling applications using insert, diamond, and polycrystallines diamond compact bits. Other hot-hole applications are currently being drilled successfully or planned in other states, both on- and off-shore. The turbodrill is devoid of any elastomers or other temperature-sensitive materials, hence, its capabilities are closely matched to the requirements of the industry. The bearing assembly can withstand the rigors found in the drilling of typical geothermal formations and provide the performance necessary to stay in the hole, thus providing increased penetration rates and, hence, more economical drilling. This paper will present case histories of recent turbodrill performances in all areas where used. Furthermore, data will be presented showing the performance of insert, diamond, and polycrystalline diamond bits as they relate to the turbodrill, together with forecasts as to the potential that turbodrills have to offer in accelerating and controlling the drilling of geothermal wells.

30356 (SAND—81-0036C, pp 11.1-11.18) **Behavior of polycrystalline diamond compact cutters while drilling in bottomhole conditions - field applications.** Cortes, J.; Besson, A. (Compagnie Francaise des Petroles, Boulogne, France). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Research carried out during several years on polycrystalline diamond compact cutters is described. The research included two main parts: 1) laboratory study on the behavior of polycrystalline diamond cutters; and 2) field applications. A drilling simulator was developed to show the elastoplastic destructive rock behavior under bottomhole conditions. Major characteristics of the simulator were: 1) rotating speed up to 300 rpm; 2) test pressure up to 600 bars; 3) visualizaion of cutter action with a high-speed camera with up to 10,000 pictures/second; 3) measurement of cutter temperature while drilling; and measurements of the bit weight, torpue, rate of penetration, and bottomhole pressure. The results allowed the definition of the different parameters that improve the rate of penetration such as rake angle, clearance angle, side clearance angle, and cutter configuration. Following the laboratory results, new drill bits were designed and field tested. From the numerous tests which were performed in the field, it is then possible to compare standard bits with new bits in the same drilling conditions. Major emphasis was given to a study of turbodrilling and bit performance at high rotating speeds.

30357 (SAND—81-0036C, pp 12.1-12.28) **Geothermal cementing: the state of the art.** Shryock, S.H. (Halliburton Services, Norwalk, CA); Smith, D.K. 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Much emphasis today is being placed on the drilling and completion of steam wells. Success or failure depends greatly on the cementing process, which requires not only the selection of competent and durable materials but also the complete understanding of placement techniques. Immobile muds, crooked holes, lost circulation, poor centralizaton, and the inability to move pipe are some of the major areas which contribute to good or bad results. This presentation covers a state of the art of the various techniques, materials, and equipment being used in cementing steam wells in the United States and Mexico. Two new techniques which aid in achieving full hole coverage and in sealing lost circulation zones during cementing are highlighted.

30358 (SAND—81-0036C, pp 13.1-13.16) **Current status of geothermal well cement development.** Kukacka, L.E. (Brookhaven National Lab., Upton, NY). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

The results of a study made in 1976 indicated that the cements used for well completion deteriorate in the geothermal environments and that the life expectancy of a well, and therefore the economics of geothermal processes, could be improved significantly if better materials were developed. On the basis of this assessment, Brookhaven National Laboratory (BNL) helped the Department of Energy, Division of Geothermal Energy to organize a program to develop materials that meet the estimated design criteria for geothermal well cements. The BNL work involves research on polymer cements and full management of an integrated program involving contract research and industrial participation. The program consists of the following phases: (1) problem definition, (2) cement research and development, (3) property verification, (4) downhole testing, and (5) cementing of demonstration wells. In this paper, results obtained in Phases 1, 2 and 3 of the work are summarized and the current status of the downhole testing phase presented.

30359 (SAND—81-0036C, pp 14.1-14.18) **Downhole temperature prediction for drilling geothermal wells.** Mitchell, R.F. (Enertech Engineering and Research Co., Houston, TX). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Unusually high temperatures are encountered during drilling of a geothermal well. These temperatures affect every aspect of drilling, from drilling fluid properties to cement formulations. Clearly, good estimates of downhole temperatures during drilling would be helpful in preparing geothermal well completion designs, well drilling plans, drilling fluid requirements, and cement formulations. The thermal simulations in this report were conducted using GEOTEMP, a computer code developed under Sandia National Laboratories contract and available through Sandia. Input variables such as drilling fluid inlet temperatures and circulation rates, rates of penetration, and shut-in intervals were obtained from the Imperial Valley East Mesa Field and the Los Alamos Hot Dry Rock Project. The results of several thermal simulations are presented, with discussion of their impact on drilling fluids, cements, casing design, and drilling practices.

30360 (SAND—81-0036C, pp 15.1-15.14) **High temperature geothermal elastomer compound development.** Hirasuna, A.R. (L'Garde, Inc., Newport Beech, CA). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Reliable casing packer seal elastomers for the unusually severe geothermal environment at 260°C (500°F) did not exist in 1976. L'Garde, Inc., was awarded a contract to fulfill this need by the United States Department of Energy. Successful development was completed in 1979. Compounds based on four different polymer systems were developed, all of which exceed the contract requirements. Successful laboratory tests above 300°C (575°F) have been performed with packer seals. Field tests to temperatures as high as 317°C (603°F) have been performed on static 0-rings in a cablehead. Successful, dynamic, drill bit seal tests were run with a presoak temperature of 288°C (550°F). The successful compounds are based on the following polymer systems: EPDM (Nordel), FKM (Viton), EPDM/FKM (Nordel/Viton) blend, and propylene-TFE (AFLAS). Evaluation was performed on full-scale packer seals as well as on 0-rings by L'Garde. L'Garde ran comparison tests against commercially available elastomers including Kalrez. Case experience with one or more of the developed compounds are presented. The applications cited include blowout preventors, dynamic drill bit seals, packers, and cableheads. Finally, an effort to actively transfer this technology to the industry is described.

30361 (SAND—81-0036C, pp 16.1-16.18) **Drilling, completing, and maintaining geothermal wells in Baca, New Mexico.** Pye, S. (Union Geothermal, Santa Rosa, CA). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

A 55-MWe power plant is planned for development in the Baca location in the Jemez Mountains of New Mexico. Union Geothermal has contracted to provide the steam for the power plant. This paper uses Baca Well No. 13 as a case history to describe the drilling methods, casing program, cementing program, and completion methods used by Union. The discussion includes aerated-water. Lost circulation control in mud drilling and its effort on the subsequent casing cementing program are discussed. The paper also includes a case history of scale removal methods used in Baca Well No. 11, including drilling the scale out with a turbodrill and attempts at chemical inhibition.

30362 (SAND—81-0036C, pp 17.1-17.20) **Geothermal well completions in Cerro Prieto.** Dominguez, B.; Cobo Rivera, J.M. (Comision Federal de Electricidad de Mexico, Calexico, CA). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Geothermal well completion criteria have evolved from 1964 to this date. The evolution started with the common techniques used in oil-well completion and gradually changed to accommodate the parameters directly related to the mineralogic characteristics of the geothermal fluids. While acceptable completions can now be achieved, research techniques and data collection should be improved to optimize the procedures.

30363 (SAND—81-0036C, pp 18.1-18.12) **New bridge plug and retrieving tool that aids completion of geothermal steam wells.** Harris, A. (Halliburton Services, Duncan, OK); Thompson, P.; Ash, D. 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

A typical completion procedure requires placement of a bridge plug near the liner top of a producing steam well so the well can be loaded to permit cementing of the tieback casing string by conventional cementing techniques. A drillable bridge plug has been used in the past so that it could be removed with a conventional toothed, cone-type drill bit. All components could not be drilled out because the bridge plug would separate from the casing when drilling through its top slips. This created a hazardous situation because heavy components remaining in the well could blowout after placing the well into production and damage or destroy surface equipment. A bridge plug and its companion milling-type retrieving tool were developed to perform the bridging operation and accomplish removal in a producing geothermal steam well environment. The bridge plug features an internal bridging plug that is designed to permit the release of differential pressure buildup from below before releasing the bridge plug by milling away the top slips. The milling-type retrieving tool has a catcher mechanism designed to function in the high-velocity steam flow of a producing well to catch the released bridge plug. After the released bridge plug components are caught, they may be returned to the surface in a controlled manner. This removes the massive components so that they will not be blown out by the steam of a producing well. Field use has demonstrated that this equipment is a practical completion aid, and it is currently being used in The Geysers field of northern California. Examples of field usage are discussed in the paper.

30364 (SAND—81-0036C, pp 19.1-19.20) **Geothermal well maintenance and repair in Cerro Prieto.** Dominguez, B.; Vital Blaneo, F. (Comision Federal de Electricidad de Mexico, Calexico, CA). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

When the first well is drilled at a geothermal field, procedures for the cleaning, repair, and control of wells should be established. This aspect will be increasingly important as more wells are drilled. Equipment, tools and techniques need to be improved to achieve economic and safe results. Different systems have been developed and applied in maintenance of wells, in problems of casing incrustations, repairs, plugging, and well control. These systems should be improved, even though they have been reasonably satisfactory to date.

30365 (SAND—81-0036C, pp 20.1-20.22) **Integrated geothermal well testing: test objectives and facilities.** Nicholson, R.W.; Vetter, O.J. 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

A new and highly integrated geothermal well test program was designed for three geothermal operators in the United States (MCR, RGI and Mapco Geothermal). This program required the design, construction and operation of new well test facilities. The main objectives of the test program and facilities are to investigate the critical potential and worst problems associated with the well and produced fluids in a period of approximately 30 days. Field and laboratory investigations are required to determine and quantify the problems of fluid production, utilization and reinjection. The facilities are designed to handle a flow rate from a geothermal well of one million pounds per hour at a wellhead temperature of approximately 268°C (515°F). The facilities will handle an entire spectrum of temperature and rate conditions up to these limits. All pertinent conditions for future fluid exploitations can be duplicated with these facilities, thus providing critical information at the very early stages of field development. The new well test facilities have been used to test high temperature, liquid-dominated geothermal wells in the Imperial Valley of California. The test facilities still have some problems which should be solvable. The accomplishments of this new and highly integrated geothermal well test program are described in this paper.

30366 (SAND—81-0036C, pp 21.1-21.18) **Review of the Geothermal Reservoir well Stimulation Program.** Campbell, D.A. (RepubliWell S Geothermal, Inc., Santa Fe Springs, CA); Sinclair, A.R.; Hanold, R.J.; Vetter, O.J. 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

The overall Geothermal Reservoir Well Stimulation Program and the four treatments completed to date are described. Phase I consists of literature and theoretical studies, laboratory investigations, and numerical work. Phase II will include the planning, execution, and evaluation of six well stimulation treatments which utilize the technology developed in Phase I. The results of stimulation experiments performed at Raft River, Idaho and East Mesa KGRA were evaluated using short-term production tests, conventional pressure transient analysis, interference pressure data, chemical and radioactive tracers, borehole acoustic televiewer surveys and numerical models. This combination of evaluation techniques yielded an interpretation of fracture geometry and productivity enhancement. However, the evaluation of artificially induced fractures in naturally fractured formations was found to lead to possibly non-unique solutions. In all the field experiments, artificial fractures were created and well productivity was increased. A discussion of the prestimulation and poststimulation data and their evaluation are provided for each experiment in this report.

30367 (SAND—81-0036C, pp 22.1-22.16) **Acidization of a direct heat hydrothermal well and its potential in developing additional direct heat projects.** Dolenc, M.R. (EG and G Idaho, Inc., Idaho Falls); Strawn, J.A.; Prestwich, S.M. 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

A matrix acid treatment on a limestone formation in a low temperature hydrothermal production well in South Dakota has resulted in a 40% increase in heat (Btu) available for use in space heating a hospital. The results of this experimental treatment on the Madison Limestone suggest a significant potential may exist for similar applications, particularly throughout the western United States. This paper presents the results of the acid treatment, suggests other possible areas for similar application, and analyzes the economics for successful treatments.

30368 (SAND—81-0036C, pp 23.1-23.18) **Lost circulation experience in geothermal wells.** Goodman, M.A. (Enertech Engineering and Research Co., Houston, TX). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Assessment of the general drilling and completion practices commonly used for handling lost circulation have been surveyed and evaluated under a study sponsored by Sandia National Laboratories. Results of this study, including interviews with geothermal production companies and with drilling fluid service companies, are reported. Lost circulation in geothermal wells is generally very different from lost circulation in petroleum wells. Conventional lost circulation materials and squeeze cementing are not always successful in the cavernous and vugular low-pressure formations encountered in geothermal reservoirs. Special completion methods, such as liner and tieback string, are often used to improve cement placement and setting in lost circulation zones. High wellbore temperatures during geothermal cementing magnify the lost circulation problem. Cement retarders may be needed to prevent premature setting at the higher temperatures, yet too much retarder may lead to an unsuccessful completion, particularly because of the large volume of cement that may be required to seal a lost circulation zone. Conclusions and recommendations are presented for control of lost circulation during geothermal operations. Recent improvements in lost circulation materials and techniques and potential equipment solutions to the lost circulation problem are discussed. Research needs are also identified.

30369 (SAND—81-0036C, pp 25.1-25.20) **Recent developments in geothermal drilling fluids.** Kelsey, J.R. (Sandia National Lab., Albuquerque, NM); Rand, P.B.; Nevins, M.J.; Clements, W.R.; Hilscher, L.W.; Remont, L.J.; Matuala, G.W.; Bailey, D.N. 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

In the past, standard drilling muds have been used to drill most geothermal wells. However, the harsh thermal and chemical environment and the unique geothermal formations have led to such problems as excessive thickening of the fluid, formation damage, and lost circulation. This paper describes three recent development efforts aimed at solving some of these drilling fluid problems. Each of the efforts is at a different stage of development. The Sandia aqueous foam studies are still in the laboratory phase, NL Baroid's polymeric deflocculant is soon to be field tested, and the Mudtech high-temperature mud was field tested several months ago. Low density and the capability to suspend particles at low relative velocities are two factors which make foam an attractive drilling fluid. The stability of these foams and their material properties at high temperatures are presently unknown and this lack of information has precluded their use as a geothermal drilling fluid. The aqueous foam studies being conducted at Sandia are aimed at screening available surfactants for temperature and chemical stability. Approximately 100 surfactants have been tested at temperatures of 260° and 310°C (500° and 590°F), and several of these candidates appear very promising. NL Baroid has developed a polymeric deflocculant for water-based muds which shows promise in retarding thermal degradation effects and associated gelation. Formulations containing this new polymer have shown good rheological properties up to 260°C (500°F) in laboratory testing. A high-temperature mud consisting primarily of sepiolite, bentonite, and brown coal has been developed by Mudtech, Inc. A field test of this mud was conducted in a geothermal well in the Imperial Valley of California in May 1980. The fluid exhibited good hole-cleaning characteristics and good rheological properties throughout the test.

30370 (SAND—81-0036C, pp 26.1-26.22) **Reactions of attapulgite and sepiolite in high-temperature drilling fluids.** Guven, N. (Texas Tech Univ., Lubbock); Carney, L.L.; Lee, L.J. 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

The fibrous clay minerals attapulgite and sepiolite have been subjected to hydrothermal reactions between 149°C (300°F) and 427°C (800°F). A 4% suspension of each of these clays was autoclaved for 16 to 24 hours with and without the addition of salts of NaCl and KCl at 204°C (400°F) to a smectite with a lamellar morphology. In fact, attapulgite converts more readily than sepiolite, and the attapulgite-to-smectite transformation is fully completed at 316°C (600°F), whereas 20% to 50% of the sepiolite remains intact at this temperature. The conversion of the fibrous double- and triple-chain silicates of attapulgite and sepiolite to a layered silicate, such as smectite, favorably affects the rheology of the drilling fluids

based on these clays. The mechanism of the conversion is, however, different for these fibrous clays. Attapulgite dissolves first and then smectite precipitates whereas this mechanism takes place for sepiolite at 316°C (600°F). Both attapulgite and sepiolite, and their reaction products, have been examined with an analytical electron microscopy (JEM-100CX) in TEM, STEM, SEM, and SAD modes. The intensities of the characteristic X-ray spectra for the elements Mg, Al, Si, Fe, Ca, and K are measured. These observations indicate that (1) significant chemical differences exist between the fibrous clays and the smectites formed from them and (2) morphological features of the smectites vary with the temperature and with the presence of the salts in the system.

30371 (SAND—81-0036C, pp 27.1-27.18) **Mechanisms of formation damage in matrix permeability geothermal wells.** Bergosh, J.L.; Wiggins, R.B.; Enniss, D.O.; Jones, A.H. (Terra Tek, Inc., Salt Lake City, UT). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

Matrix permeability geothermal formations are subject to damage during well drilling and completion. Near well bore permeability impairment that may occur as a result of particulate invasion, and chemical interaction between formation clays, drilling mud filtrates and formation brines is investigated. Testing of various filtration chemistries on the permeability of East Mesa sandstones indicates that permeability is significantly impaired by the flow of low salinity formation brines. This damage is attributed to cation exchange and removal processes which alter the stability of clay structures. Fluid shearing dislodges particles, which clog pore throats, irreversibly reducing permeability. The test program investigating the effects of mud-transported particles on geothermal formation is still in progress. The rationale, apparatus and test procedures are described. Final results of this testing will be presented at the conference.

30372 (SAND—81-0036C, pp 28.1-28.28) **Drill pipe corrosion control using an inert drilling fluid.** Caskey, B.C.; Copass, K.S. (Sandia National Lab., Albuquerque, NM). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

The results of a geothermal drill pipe corrosion field test are presented. When a low-density drilling fluid was required for drilling a geothermal well because of an underpressured, fractured formation, two drilling fluids were alternately used to compare drill pipe corrosion rates. The first fluid was an air-water mist with corrosion control chemicals. The other fluid was a nitrogen-water mist without added chemicals. The test was conducted during November 1980 at the Baca location in northern New Mexico. Data from corrosion rings, corrosion probes, fluid samples and flow line instrumentation are plotted for the ten day test period. It is shown that the inert drilling fluid, nitrogen, reduced corrosion rates by more than an order of magnitude. Test setup and procedures are also discussed. Development of an onsite inert gas generator could reduce the cost of drilling geothermal wells by extending drill pipe life and reducing corrosion control chemical costs.

30373 (SAND—81-0036C, pp 29.1-29.20) **Inert gas generation utilizing diesel exhaust.** Osgerby, I.T.; Durilla, M. (Engelhard Industries, Edison, NJ). 1981. NTIS, PC A23/MF A01.

From International geothermal drilling and completions technology conference; Albuquerque, NM, USA (21 Jan 1981).

The generation of inert gas from 60 KW diesel engine exhaust by catalytic reduction of O_2 and NO/sub x/ has been demonstrated. Measured O_2 levels were < 10 V/sub ppM/ and NO/sub x/ levels were ≃ 0.1 VppM over a wide range of equivalence ratios. Durability of the catalytic converter was demonstrated up to 200 hours operating time at two diesel engine load conditions. Effective catalyst operating range was stoichiometric to rich fuel/air ratios. Optimum operation is at stoichiometric fuel/air ratios to minimize CO emissions. Alternative converter designs are proposed to allow operation over the full diesel engine load range with essentially zero emissions of O_2, NO/sub x/ and CO.

30374 **Cure-in-place process for seals.** Hirasuna, A.R. (to Department of Energy). US Patent 4,244,908. 13 Jan 1981. Filed date 22 Mar 1979. vp.

PAT-APPL-022896.

A cure-in-place process which allows a rubber seal element to be deformed to its service configuration before it is cross-linked and, hence, is a plastic and does not build up internal stress as a result of the deformation. This provides maximum residual strength to resist the differential pressure. Furthermore, the process allows use of high modulus formulations of the rubber seal element which would otherwise crack if cured and then deformed to its service configuration, resulting in a seal which has better gap bridging capability. Basically, the process involves positioning an uncured seal element in place, deforming it to its service configuration, heating the seal element, curing it in place, and then fully seating the seal.

30375 **Effect of permeability on cooling of magmatic intrusion in a goethermal reservoir.** Lau, K.H. (Univ., of Hawaii, Hilo). *Transactions - Geothermal Resources Council ;* **4**: 133-136(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Transient cooling of magmatic intrusion in a geothermal reservoir due to conduction and convection is studied. The effects of overlying cap rock and different horizontal and vertical permeability of the reservoir are considered. Results are compared to the data from Salton Sea Geothermal Field. It is also observed that multiple layers of convection cells exist when horizontal permeability is much larger than the vertical permeability. The sharp dropoff of surface heat flow observed at Salton Sea Geothermal Field is confirmed by numerical results. Based on these numerical results, it is possible to speculate that the age of the intrusive body is about 8000 to 12,000 years.

30376 **Directional drilling operations Hot Dry Rock well EE-2.** Brittenham, T.L.; Williams, R.E.; Rowley, J.C.; Neudecker, J.W. (Grace, Shursen, Moore and Associates, Amarillo, TX). *Transactions - Geothermal Resources Council ;* **4**: 273-276(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Directional drilling of deviated geothermal wells in hot granite poses several severe equipment and instrumentation problems. The Los Alamos Scientific Laboratory (LASL) Hot Dry Rock (HDR) geothermal reservoir analyses indicate that boreholes with a significant inclination provide access to hydraulic fracturing of a large volume of reservoir rock. The first well (Energy Extraction No. 2; EE-2) of a pair of wells planned to test this concept was successfully directionally drilled at the Fenton Hill, NM, experimental site. The well was deviated by 180° in azimuth and the bottom part was drilled at 35° to the vertical. The downhole directional drilling equipment, steering tools, and operational procedures used are presented. Problems encountered were directly related to the rough drilling in the hard granite and high temperature, 275°C (530°F), at the total depth of 4.661 km (15,292 ft). Results of the EE-2 directional program were used to optimize the directional drilling of the second well EE-3.

30377 **Drilling fluid/formation interaction at simulated in situ geothermal conditions.** Enniss, D.O.; Bergosh, J.L.; Butters, S.W.; Jones, A.H. (Terra Tek, Inc., Salt Lake City, UT). *Transactions - Geothermal Resources Council ;* **4**: 285-288(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Interaction of drilling fluids with a geothermal reservoir formation can result in significant permeability impairment and therefore reduced well productivity. This interaction is studied under simulated in situ geothermal conditions of overburden stress, pore fluid pressure, temperature and pore fluid chemistry. Permeability impairment of an East Mesa KGRA reservoir material is evaluated as a function of stagnation time, drilling fluid and temperature. Results indicate that ll of these parameters contribute significantly to the magnitude and the reversibility of the impairment.

30378 Development and testing of seals and lubricants for geothermal rock bits. Hendrickson, R.P.; Winzenried, R.W. (Terra Tek, Inc., Salt Lake City, UT). *Transactions - Geothermal Resources Council ;* **4**: 293-296(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The successful development and evaluation of seals and lubricants for journal-type rock bits for use in geothermal reservoirs are described. Elastomeric compounds which sealed effectively to temperatures of 288°C (550°F), and mechanical seals for reservoir temperatures over 288°C (550°F) are presented. Newly developed lubricants which meet both the compatibility and lubrication requirements are described. Several seals and lubricants are recommended for high temperature laboratory drilling and field geothermal drilling tests in rollercone bits.

30379 Development of turbodrill tachometer. McDonald, W.J.; Maurer, W.C.; Neudecker, J.W.; Shoemaker, H.D. Contract AC21-79MC11251. *Transactions - Geothermal Resources Council ;* **4**: 301-304(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

A reliable tachometer has been developed for use with turbodrills. The tachometer utilizes a set of partially blanked turbine blades to produce a pressure pulse in the drilling mud flow stream each time the turbodrill rotates one revolution. The pressure pulses are transmitted through the mud in the drill pipes to the surface where they are detected, processed and RPM read out. The frequency of the pulse signals is a direct measure of the turbodrill rotary speed. Drilling motor test stand trials demonstrated the reliability and accuracy of the tachometer. The pulsing blades were then installed on geothermal turbodrills used in drilling the Los Alamos Scientific Laboratory geothermal well EE-2. The tachometer allowed continual monitoring and control of turbodrill speed at LASL and was successfully used to depths in excess of 10,000 feet. The success of the high temperature turbodrills in EE-2 is attributed in part to the tachometer.

30380 Interference between wells in a fractured formation. Ehlig-Economides, C.; Economides, M.J.; Miller, F.G. (Stanford Univ., CA). *Transactions - Geothermal Resources Council ;* **4**: 321-324(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Geothermal formations are often characterized by extensive fracturing. Because the rock matrix has very low permeability, the fracture system provides the main conduit for fluid flow. Therefore, radial flow assumptions may not be applicable to geothermal fluid flow. Linear flow may be a more likely configuration. This paper presents a method of pressure interference analysis using a linear flow model. An example of application for an interference test at The Geysers is included.

30381 Shale recharge and production behavior of geopressured reservoirs. Garg, S.K. (Systems, Science and Software, La Jolla, CA). Contract AC08-79ET27202. *Transactions - Geothermal Resources Council ;* **4**: 325-328(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The reservoir simulator MUSHRM was used to study the conditions under which significant shale recharge may be expected. The calculations presented herein show that shale recharge is a strong function of the vertical shale permeability but is not greatly influenced by the shale compressibility. Significant shale recharge will occur only if the vertical shale permeability is at least of the order of 0.01 μd.

30382 Study of drawdown and buildup tests in wells with phase boundaries. Horne, R.N.; Satman, A. (Stanford Univ., CA). *Transactions - Geothermal Resources Council ;* **4**: 345-347(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

This investigation considers the pressure transient analysis of wells completed in two-phase geothermal reservoirs. Due to pressure reduction caused by production, boiling may take place in the reservoir resulting in concentric two-phase and liquid conditions around the well. Alternatively, during injection of water into a two-phase reservoir the reverse configuration may appear. This situation may be represented as a radial discontinuity in mobility and/or diffusivity in the reservoir. It is found that permeabilities may be determined in both regions and in many cases the volume and porosity of the inner region may also be calculated.

30383 Degradation of polymers used in geothermal fracturing. Caenn, R.; Tyssee, D.A.; Vetter, O.J. (Vetter Research, Costa Mesa, CA). *Transactions - Geothermal Resources Council ;* **4**: 413-415(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Long chain, water soluble polymers have been used for many years in hydraulic fracturing of oil wells. Recently their use has been attempted in geothermal wells. Very little is known about the high temperature degradation of these polymers other than an extreme viscosity drop as the temperature goes to 150°C. This paper describes the development of methods in the laboratory to charaterize the degradation at temperatures of 150°C and above. Examined were hydroxyethyl cellulose (HEC) and hydroxypropyl guar gum (HP Guar) at 150°, 200° and 250°C. The chemical tests performed on the samples were carbohydrate content, total organic carbon, and molecular weight distribution by high pressure liquid chromatography (HPLC). Hopefully, these tests can be used in the future to predict physical properties of fracturing polymers such as viscosity loss and formation plugging.

30384 Geothermal reservoir initial state, Baca Location No. 1, New Mexico, Redondo Creek field. Atkinson, P.G. (Union Oil Co. of California, Santa Rosa). *Transactions - Geothermal Resources Council ;* **4**: 435-438(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

It is important to identify the thermodynamic state of a geothermal reservoir prior to developing it. Distinguishing between compressed liquid and two-phase steam-water systems is critical in reservoir engineering analysis of field data. Data pertaining to the initial state of the Redondo Creek geothermal system are reviewed. The data presented and discussed demonstrate that the bulk of the hydrothermal system contains compressed, hot liquid. A few of the wells have encountered separate steam or two-phase reservoirs which do not appear to be in communication with the main liquid system, except possibly via the wellbore.

30385 Case study of two-phase flow at the Roosevelt Hot Springs, Utah KGRA. Butz, J.R. (Denver Research Inst., CO). Contract AS08-77ET28389. *Transactions - Geothermal Resources Council ;* **4**: 439-442(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

A well in the Roosevelt Hot Springs, Utah KGRA was flowed in 1978 and 1979 to obtain pressure and temperature profiles in the two-phase (steam/water) zone. Both parameters were measured simultaneously and in real time, as a function of depth. Under flowing conditions, the maximum temperature recorded was 503°F (262°C) and maximum pressure, 954 psia (6.58 MPa). Flow rates as high as 580,000 lb/hr (73.3 kg/sec) total flow were measured using a modified James method. Comparison of test results with output of a two-phase flow computer model was performed. Model results matched test data quite well at flow rates below 300,000 lb/hr (38 kg/sec); above that level, increasing deviation from test data was noted with increasing flowrate. The computer model was used to investigate the effects of casing diameter and Producitivty Index on the flowrate that could be sustained for a fixed wellhead pressure. For example, a well with 13 3/8 inch diameter casing is predicted to have a 24% greater flowrate than can be sustained in the current 9 5/8 inch diameter well. The impacts of both diameter and PI are significant, and results show that well design can be optimized to maximize production when reservoir parameters are known.

30386 **Private commercial HDR energy extraction program: technical details, expectations for power generation and proprietary procedures.** Foster, J.W. (HDR Energy Development Corp., Augusta, GA). Contract EY-76-5-02-2686. *Transactions - Geothermal Resources Council ;* **4**: 503-506(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Details of the first private commercial program for the extraction of heat energy in quantity from hot dry rock are presented. The operation, a carry-forward of the on-going vital basic research by the Los Alamos Scientific Laboratory, has a target net production of 20.7 MW (e) from a yield of 104 MW (t) per earth loop. The program includes three loops. Successful execution of the Corporate design will result in about 50,000 M^2 of fracture per kilogram/second of fresh water fluid extraction, requiring the achievement of 18 parallel en-echleon vertical fractures in each loop. The summary reviews the principles of rock mechanics involved, outlines the specific advantages of the proprietary procedures, describes the site area elected for Operation No. One, energy economics and the reasons for confidence that the design can be executed. The Program is intended to result in a prototype installation which represents the beginning of HDR energy as a commercially viable, environmentally clean and inexhaustible source of power on an energy hungry planet.

1510 Direct Energy Utilization

30387 **(DOE/ET/28440—T1) Geothermal space/water heating for City of Mammoth Lakes, California. Draft final report.** Sims, A.V.; Racine, W.C. (Holt (Ben) Co., Pasadena, CA (USA)). Sep 1977. Contract AC03-76ET28440. 148p. NTIS, PC A07/MF A01. Order Number DE81027040.

The results of a study to determine the technical, economic and environmental feasibility of geothermal district heating for Mammoth Lakes Village, California are presented. The geothermal district heating system selected is technically feasible and uses existing technology in its design and operation. During a preliminary environmental assessment, no potential adverse environmental impacts could be identified of sufficient consequence to preclude the construction and operation of the proposed district heating system. A follow-on program aimed at implementing district heating in Mammoth is outlined.

30388 **(DOE/SF/01975—T1) Geothermal heating for Caliente, Nevada.** Wallis, F.; Schaper, J. (Agua Caliente Trailer Park, Caliente, NV (USA); Grover C. Dils Medical Center, Caliente, NV (USA)). Feb 1981. Contract FG03-78SF01975. 29p. NTIS, PC A03/MF A01. Order Number DE81027821.

Utilization of geothermal resources in the town of Caliente, Nevada (population 600) has been the objective of two grants. The first grant was awarded to Ferg Wallis, part-owner and operator of the Agua Caliente Trailer Park, to assess the potential of hot geothermal water for heating the 53 trailers in his park. The results from test wells indicate sustainable temperatures of 140° to 160°F. Three wells were drilled to supply all 53 trailers with domestic hot water heating, 11 trailers with space heating and hot water for the laundry from the geothermal resource. System payback in terms of energy cost-savings is estimated at less than two years. The second grant was awarded to Grover C. Dils Medical Center in Caliente to drill a geothermal well and pipe the hot water through a heat exchanger to preheat air for space heating. This geothermal preheater served to convert the existing forced air electric furnace to a booster system. It is estimated that the hospital will save an average of $5300 in electric bills per year, at the current rate of $.0275/KWH. This represents a payback of approximately two years. Subsequent studies on the geothermal resource base in Caliente and on the economics of district heating indicate that geothermal may represent the most effective supply of energy for Caliente. Two of these studies are included as appendices.

30389 **Identification of prospective industrial geothermal energy users.** Coe, B.A.; Bright, P.; Meyer, R.T. (Western Energy Planners, Ltd., Denver, CO). Contract AC07-80ID12101. *Transactions - Geothermal Resources Council ;* **4**: 553-555(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

An industrial plant may decide to convert to geothermal energy of adequate quality and quantity. For a company to decide to open a plant at a new site or to relocate an existing plant at a site where geothermal energy can be used is a much more complex decision. An approach for identifying those industries that might realistically be candidates for relocation or expansion to geothermal sites is described.

30390 **Feasibility of a retrofit geothermal heating system for the University of New Mexico campus.** Kauffman, D.; Houghton, A.V.; Cortner, J.C.; Lee, M.C.; Moyers, C.F.; Ungan, A.; Vogel, J.E. (Univ. of New Mexico, Albuquerque). Contract AS07-79ID12048. *Transactions - Geothermal Resources Council ;* **4**: 577-579(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The potential engineering and economic feasibility of low-temperature geothermal energy applications on the campus of the University of New Mexico are being studied. The program has three principal parts: data gathering and analysis, system synthesis and selection, and system refinement and implementation planning. The first two parts are essentially complete; the third is in progress.

30391 **Boise geothermal district heating system: technical design.** Little, N.H.; Bissell, R.R. (CH2M Hill, Inc., Boise, ID). Contract FC07-79ET27053. *Transactions - Geothermal Resources Council ;* **4**: 585-588(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Two 10 megawatt geothermal district heating systems are being developed by Boise City and the Boise Warm Springs Water District for Boise, Idaho. These systems will provide 170°F geothermal water for space heating in the downtown and eastern portions of the city. The major technical aspects of the preliminary design for the Boise geothermal district heating system are summarized. In general, the discussion also applies to the Boise Warm Springs Water District system.

30392 **Target industries for geothermal direct heat applications.** Meyer, R.T. (Western Energy Planners, Ltd., Denver, CO). Contract AC07-80ID12101. *Transactions - Geothermal Resources Council ;* **4**: 589-592(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Available energy consumption data for 455 mining and manufacturing industries have been compiled, evaluated and screened for the purpose of identifying target industries for geothermal direct heat applications. Only industrial processes requiring process temperatures less than or equal to 400°F and only industries utilizing equal to or greater than 0.01×10^{12} Btu/year/establishment are placed on the target list. The target list contains 65 4-digit SIC industries totaling 19,728 establishments in the United States. The maximum energy market share for direct heat applications is estimated to be 3.632 quads (based upon 1977 data), of which 2.568 quads is represented by the 65 industries.

30393 **Unitary water-source heat pumps for geothermal applications: availability, performance and design.** Reistad, G.M.; Means, P. (Oregon State Univ., Corvallis). *Transactions - Geothermal Resources Council ;* **4**: 601-604(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Residential size water-source heat pumps that may be used for space heating in conjunction with geothermal energy are marketed by a large number of companies in the US. These units however, are recommended for operation in only a portion of the geothermal resource temperature range for which space heating with

heat pumps and geothermal resources has been shown to be applicable. Calculations reveal that good performance and good use of the geothermal resource can be obtained for the whole range of geothermal resource temperatures, for which this type of system has been indicated, when the heat pump unit is redesigned to match the prevailing resource temperature and have an acceptable temperature drop. The performance and required fluid flow rate values summarized here allow a better evaluation of the true potential for geothermal space heating using residential size heat pumps than do the values reported for present off-the-shelf heat pump units.

30394 **Autohydrolysis: a process system for utilizing geothermal fluids in converting lignocellulose biomass to alcohol fuels.** Schmitt, R.C.; Murphy, V.G. (EG and G Idaho, Inc., Idaho Falls). Contract AC07-76ID01570. *Transactions - Geothermal Resources Council ;* 4: 609-612(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Information is provided on a process system to couple the use of geothermal fluids to the conversion of lignocellulose biomass to alcohol. Results to date, including completed laboratory scale data for wheat straw indicate the process is relatively low temperature and compatible with a large number of geothermal resources. The process appears to be equal and perhaps superior to that of competitive lignocellulose conversion processes being evaluated for general application such as acid hydrolysis, bacterial treatment, enzymes, and other methods. Because of the changes in the magnitude of the INEL involvement in the alcohol fuels program including the possibility of diverting the autohydrolysis process work to other than geothermal fluid applications, it is considered timely to apprise the geothermal community on the promising and largely unreported results to date.

30395 **Alcohol production: an appropriate use of hydrothermal energy.** Stiger, R.R. (EG and G Idaho, Inc., Idaho Falls). *Transactions - Geothermal Resources Council ;* 4: 621-623(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Hydrothermal energy is an appropriate form of energy for alcohol production because: (1) it is a technically feasible method to convert a nonportable source of energy into a portable form using commercially available technology; (2) a large amount of hydrothermal energy is available in a temperature range suitable for alcohol production; and (3) alcohol production with hydrothermal energy is cost and energy efficient.

30396 **Preliminary identification of potential geothermal energy uses in the Tennessee Valley region.** Treat, N.L.; Levison, C.H. (Oak Ridge Associated Universities., TN). Contract AC05-76OR00033. *Transactions - Geothermal Resources Council ;* 4: 625-627(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

This study identifies potential commercial applications of low-grade geothermal energy in the Tennessee Valley region, which includes the states of Tennessee, Kentucky, and parts of adjacent states. The most promising geothermal resources within this region are located in the New Madrid seismic zone, where aquifer temperatures of 158 to 194°F are projected. Criteria for the selection of potential applications of geothermal energy to processes other than space heating and cooling are presented. This is followed by a discussion of commercial and industrial processes that have been tentatively identified as viable uses of geothermal resources, including textile finishing, greenhouses, food processing, and fish hatcheries. Preliminary examinations suggest that corn and soybean milling processes may be the most promising candidates for geothermal resource applications in this region.

30397 **Direct utilization of a moderate temperature geothermal resource in agribusiness.** Zeller, T.J. (RE/SPEC Inc., Rapid City, SD); Grams, W.H.; Howard, S.M. *Transactions - Geothermal Resources Council ;* 4: 633-636(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

A demonstration project of the direct utilization of geothermal energy in a South Dakota agribusiness was undertaken. Off-the-shelf hardware was used in demonstrating that the technology was available today to develop geothermal energy resources. An existing artesian well into the Madison Formation having an energy resource of 67°C and a flow rate of 655 liters per minute was developed into an energy for grain drying and space heating. The Diamond Ring Ranch structures and the wellhead are 2500 meters apart at the farthest point and the distribution of the highly corrosive, moderate temperature resource presented several unique problems. With the completion of the construction and the operation of the system through the first heating season, the direct utilization of geothermal resources is proving economically feasible and environmentally compatible. Compatible with the ranch operations.

30398 **Analysis of benefits and costs of accelerated market penetration by a geothermal community heating system.** Barron, W.; Dubin, W.; Kane, S. (Johns Hopkins Univ., Baltimore, MD). *Transactions - Geothermal Resources Council ;* 4: 699-702(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

A potential obstacle to rapid market penetration in geothermal community heating systems resulting from the capital costs associated with joining the system is described. The analysis evaluates incentive plans based on the value of accelerated market penetration to the utility and the fixed and variable costs faced by the homeowner.

30399 **Potential for geothermal direct use in the greenhouse, lumber, chemical, and potato and onion processing industries.** Bressler, S.E. (Univ., of California, Berkeley). *Transactions - Geothermal Resources Council ;* 4: 763-765(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

It has generally been assumed that rising energy costs in industries with high energy needs for low-temperature process heat will induce increasingly widespread geothermal direct use, so long as technical feasibility and cost advantage can be demonstrated. However, few systematic attempts have been made to determine how industry management and technical personnel within these industries view this possibility in light of factors they deem important to their own firms' energy supply choices. This paper discusses that subject in relation to potential commercial geothermal use in the greenhouse, lumber, chemical, and potato and onion processing industries. It is based upon extensive interviews with decision-makers in over 50 firms representing various segments of these industries and is a selected synthesis of material compiled into reports on each industry.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 31319

30400 (CONF-800718—, pp 159-160) **Interaction of water and biotite-granodiorite rock at 198°C, 235°C, and 275°C.** Blatz, L.A.; Holley, C.E. Jr. (Los Alamos Scientific Lab., New Mexico). 1980. NTIS (US Sales Only), PC A10/MF A01.

From 3. international symposium on water-rock interaction; Edmonton, Alberta, Canada (14 Jul 1980).

Biotite granodiorite rock, 18 to 24 mesh, of approximate modal composition quartz (30%), plagioclase (40%), microcline (12%), and biotite (7%), was interacted with water, in the ratio 1 gm/15 mL water, at 198°C, 235°C, and 275°C. This rock was obtained from drill cuttings at the 9560 to 9570 foot level of the Los Alamos hot dry rock geothermal project. The samples were shaken with varying degrees of vigor in Teflon, titanium, and various steel containers, all encased in steel bombs, for 2, 4, 7, 16, 24, 48, and 96 hours, and more rarely for 8, 16, 32, and 65 days. In most cases the same rock samples were repeatedly extracted (usually five times) with fresh water for each time of extraction. The quantities studied in the aqueous phase included monomeric and total silica (by both silo-molybdate and atomic absorption analyses), pH (at room temperature), and less frequently Na^+, K^+, Al^{3+}, Ca^{2+}, Mg^{2+}, ΣFe, F^-,

and Cl^-. Studies of the solid phase included changes in weight of the rock samples after each extraction, some surface studies of the rock samples before and after extraction, and qualitative notice of the precipitates left on white micropore filters after filtration of the aqueous phases.

30401 (CONF-800718—, pp 161-162) **Interaction of water with crystalline basement rock in fractured hot dry rock geothermal reservoirs: tests and laboratory experiments.** Holley, C.; Grigsby, C.; Tester, J.; Blatz, L.; Charles, R. (Los Alamos Scientific Lab., New Mexico). 1980. NTIS (US Sales Only), PC A10/MF A01.

From 3. international symposium on water-rock interaction; Edmonton, Alberta, Canada (14 Jul 1980).

The Los Alamos Scientific Laboratory is developing a man-made geothermal reservoir in low-permeability, hot, Precambrian basement rock at Fenton Hill in the Jemez Mountains of New Mexico. The present system consists of two wells drilled to a depth of about 10,000 feet, at which depth the temperature is about 195°C, with a connection between them made by hydraulic fracturing. The rock is a biotite granodiorite, the main constituents being quartz, plagioclase and potassium feldspars, and biotite, with small amounts of sphene, epidote, calcite, and other minerals. This system was operated for three weeks in the fall of 1979, first as an open system, and then as a closed loop for the final two weeks. The results were compared with those of a 75-day test in a system using the same wells, but having a useful surface of only about 10,000 m^2. The volume of the system, ~ 50,000 gallons, and the mean residence time, ~ 8.3 hours, were measured by introducing a pulse of sodium fluorescein dye into the injection well and monitoring its recovery from the production well. The pH, Eh, conductivity, total dissolved solids, total suspended solids, and concentrations of silica, four different anions, ten different cations, and four different gases were followed.

30402 (CONF-800718—, pp 163-165) **Case for diffusion kinetics as a control on the weathering of glassy volcanic rocks at 25°C.** White, A.F. (Lawrence Berkeley Lab., CA); Claassen, H.C. 1980. NTIS (US Sales Only), PC A10/MF A01.

From 3. international symposium on water-rock interaction; Edmonton, Alberta, Canada (14 Jul 1980).

Modelling of many geochemical systems requires definition of the weathering rates of silicate rocks. Petrovic et al. (1976), Aagaard and Helgeson (1977), and Holdren and Berner (1979) suggest that weathering of crystalline silicates results from reactions at the aqueous interface. Previous experimental work in glassy silicate rocks (White and Claassen, 1979) suggested that parabolic reaction rates as functions of pH, surface to volume ratios, and specific ion concentrations can best be described by volume diffusion within the glass. A new experimental technique described here refines the model by detailing near-surface glass compositions during weathering.

30403 (CONF-800718—, pp 168-169) **Effect of glassy versus crystalline starting materials on andesite-water interactions.** Guillemette, R.N. (Stanford Univ., CA); Liou, J.G.; Dickson, F.W. 1980. NTIS (US Sales Only), PC A10/MF A01.

From 3. international symposium on water-rock interaction; Edmonton, Alberta, Canada (14 Jul 1980).

Depth- or laterally-zoned zeolite assemblagess as alteration products of volcanic glass are common in hydrothermal, diagenetic, and alkaline lake environments. In order to better understand their occurrences and parageneses, a series of hydrothermal experiments were performed to determine the effect of the presence of glass on alteration assemblages and solution compositions during water-rock interaction.

30404 (CONF-800718—, pp 170-172) **Reaction of rhyolite glass and holocrystalline basalt with NaCl solutions at 300°C; effects of time and solution compositon on alteration minerology.** Potter, J.M. (Stanford Univ., CA); Dickson, F.W. 1980. NTIS (US Sales Only), PC A10/MF A01.

From 3. international symposium on water-rock interaction; Edmonton, Alberta, Canada (14 Jul 1980).

This paper summarizes the results of an experimental study of the kinetics and solution-solid equilibria related to the interaction of volcanic rocks with $NaCl$-H_2O solutions at temperatures of 300°C and 500 bars pressure. This information is necessary to evaluate important geochemical processes operating in many geothermal systems. These studies are aimed at providing a basis for more quantitative models relating fluid flow to alteration of the rock types being used in our experiments. Rocks ground to less than 100 mesh including holocrystalline basalt from the Clear Lake volcanic field, California, and unaltered glassy rhyolite from the McDermitt Caldera, Nevada were reacted with solutions of 2, 10, and 20 weight percent NaCl in distilled H_2O. An initial solution/rock mass ratio of three was used in all experiments. Major, minor, and trace elements in solution were measured by atomic absorption and emission spectroscopy. Solids removed from the cell after quenching were characterized by x-ray and scanning electron microscope (SEM) techniques.

30405 (CONF-800718—, pp 179-182) **DLOSS, a cooperative United States-Japan research program on rock-water interaction.** Dickson, F.W. (Oak Ridge National Lab., TN). 1980. NTIS (US Sales Only), PC A10/MF A01.

From 3. international symposium on water-rock interaction; Edmonton, Alberta, Canada (14 Jul 1980).

A summary of the research of a group of Americans and Japanese (DLOSS), entitled Coordinated studies of rock-water interactions related to island-arc processes by experimental and field approaches, which began March 1978 is presented. The original aim of the research to study rock-water interactive processes relevant to the Japanese island arc was expanded to include Taiwan. Japanese workers focus on the materials and geological aspects of the field systems, and the Americans concentrate more on experimental approaches. The collective specific aims are: to determine the mineralogical, chemical, and isotopic effects on the natural materials caused by interactions in selected areas; and to measure experimentally the kinetic and equilibrium modes of interactions of appropriate rocks with natural fluids of interactions of appropriate rocks with natural fluids or simplified analogs. The conclusions and problems posed by the field data are to be correlated with and interpreted by the experimental data, to better our understanding of the genetic processes.

30406 **East Mesa rock properties at simulated in situ geothermal conditions.** Bergosh, J.L.; Van Buskirk, R.G.; Enniss, D.O.; Butters, S.W. (Terra Tek, Inc., Salt Lake City, UT). *Transactions - Geothermal Resources Council ;* **4**: 309-312(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Rock property measurments were conducted at the Terra Tek, Inc. geothermal test facility under simulated in situ conditions to characterize the matrix permeability sandstones of the East Mesa KGRA, Imperial Valley of California. Testing of the geothermal reservoir material included: electrical resistivities, mechanical response, thermal conductivities, permeability and thermal expansion. Data is also included on the physical and mineralogical properties of the sandstone. The test configuration used to determine individual rock properties is described. The results are summarized in graphical form and relevant conclusions are drawn.

30407 **Evidence of pressure solution in geothermal reservoir sandstone.** Schatz, J.F. (TerraTek, Salt Lake City, UT); Wolgemuth, K.M.; Haar, S.V. Contract W-7405-ENG-48. *Transactions - Geothermal Resources Council ;* **4**: 377-380(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Scanning electron microscope examination has been done on pre-test and post-test specimens from experiments on core from the Cerro Prieto and East Mesa geothermal fields at simulated in-situ conditions of high temperature and pressure. The microscope observations are being done in conjunction with measurements of permeability and creep compaction to provide reservoir engineering data and develop constitutive models for subsidence prediction. Evidence for pressure solution is observable as dissolution at grain contacts and overgrowth of euhedral quartz on detrital grains.

30408 Deposition of $CaCO_3$ in porous materials by flashing geothermal fluid. Michels, D.E. (Republic Geothermal, Inc., Sante Fe Springs, CA). *Transactions - Geothermal Resources Council ;* **4**: 463-466(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

Deposition of $CaCO_3$ from natural geothermal fluid was studied by using porous substrates made from several granular materials. These experiments aimed to explore connections between the process of steam flash from superheated CO_2-charged water and the consequent changes in the carbonate chemical equilibria. Fresh hot geothermal liquid flowed into the porous substrates where it flashed to steam and deposited calcite and aragonite. Interpretation of these experiments requires tracking the several factors which affect carbonate equilibria, especially $CaCO_3$ deposition, as the steam flash progresses. Those factors are viewed as components of a complex process through which the geothermal fluid passes. This point of view introduces aspects of sequence and time, providing a realistic extension from other models that are constrained to concepts of chemical equilibrium.

30409 Institutional standardization of geothermal fluid characterization techniques. Kindle, C.H. (Battelle, Pacific Northwest Lab., Richland, WA). *Transactions - Geothermal Resources Council ;* **4**: 795-799(Sep 1980). (CONF-800920—).

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The characterization of geothermal fluid has been performed over the years using a wide variety of techniques. Some of these have led to very inaccurate results with subsequent uncertainty as to the true nature of the resource. In the last years several organizations have worked to correct the situation and arrive at standard methods. The program at Battelle to achieve these ends is described. The formation of the ASTM Geothermal Resources Committee and Environmental Protection Agency efforts are related to the program. The participation of industry is described, and additional participation is solicited for this current and final phase. The complimenting parts of the Battelle Geothermal Program are described: the development of high-pressure, temperature instruments and the monitoring of the performance of operating plants (Magma's binary cycle facility).

30410 Role of second law analysis in geothermal economics. Bloomster, C.H.; Fassbender, L.A. (Battelle, Pac Northwest Lab, Richland, Wash). *Energy (Oxford) ;* **5**: No. 8-9, 839-851(Aug-Sep 1980). (CONF-790886—).

From Second law of thermodynamics workshop; Washington, DC, USA (14 Aug 1979).

Second law analysis plays an important role in the economics of geothermal energy. The second law operates mainly through the temperature of the geothermal fluid, since the sink temperature in geothermal systems, for practical purposes, is fixed by climatic conditions. The value of a geothermal fluid is largely determined by its available work, or exergy. The exergy and value of a geothermal fluid increase rapidly with temperature over the normal range of geothermal resource temperatures. Geothermal resources vary in temperature from ambient to over 300/degree/C. The cost of generating electricity from geothermal resources is very sensitive to the resource temperature, and to other factors in combination with temperature. A discussion of the paper is appended. 1 ref.

30411 Pseudopolarographic determination of metal complex stability constants in dilute solution by rapid scan anodic stripping voltammetry. Brown, S.D.; Kowalski, B.R. (Univ. of Washington, Seattle). *Analytical Chemistry ;* **51**: No. 13, 2133-2139(Nov 1979).

The theory of anodic stripping voltammetry (ASV) states that at any deposition potential, the deposition current will either be the limiting current or a fraction of the limiting current, depending on the deposition potential with respect to the metal deposition potential. By using a computer controlled anodic stripping voltammeter with automatic background correction, pseudopolarograms can be obtained by plotting the peak area vs the deposition potential for a series of stripping voltammetric runs. With ASV as a method of amplification, the ligand number and stability constants are determined for metal complexes at concentration ranges expected of natural water systems. Results for lead and cadmium with chloride and carbonate are in excellent agreement with those of less sensitive methods used at higher concentrations. No complexation of lead and cadmium was found with glycine at pH 4.68. The structure of arsenic(III) at 1.0 ng/mL in acidic solutions was determined to be $As(OH)_3$ using a gold film electrode. Finally, the speciation of lead in a geothermal water was examined by pseudopolarography and a shift consistent with a $PbCl^+$ complex was observed.

17 WIND ENERGY

REFER ALSO TO CITATION(S) 30770

1701 Availability (climatology)

30412 (DOE/BP—58) Wind power: executive summary on research on network wind power over the Pacific Northwest. Progress report, October 1979-September 1980. Baker, R.W.; Hewson, E.W. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Oct 1980. 23p. NTIS, PC A03/MF A01. Order Number DE81029360.

This research in FY80 is composed of six primary tasks. These tasks include data collection and analysis, wind flow studies around an operational wind turbine generator (WTG), kite anemometer calibration, wind flow analysis and prediction, the Klickitat County small wind energy conversion system (SWECS) program, and network wind power analysis. The data collection and analysis task consists of four sections, three of which deal with wind flow site surveys and the fourth with collecting and analyzing wind data from existing data stations.

30413 (DOE/BP—59) Network wind power over the Pacific Northwest. Progress report, October 1979-September 1980. Baker, R.W.; Hewson, E.W. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Oct 1980. 169p. NTIS, PC A08/MF A01. Order Number DE81029359.

The research in FY80 is composed of six primary tasks. These tasks include data collection and analysis, wind flow studies around an operational wind turbine generator (WTG), kite anemometer calibration, wind flow analysis and prediction, the Klickitat County small wind energy conversion system (SWECS) program, and network wind power analysis. The data collection and analysis task consists of four sections, three of which deal with wind flow site surveys and the fourth with collecting and analyzing wind data from existing data stations. This report also includes an appendix which contains mean monthly wind speed data summaries, wind spectrum summaries, time series analysis plots, and high wind summaries.

30414 (DOE/BP—60) Network wind power over the Pacific Northwest. Appendix I. Wind statistics summaries for the wind power data stations. Progress report, October 1979-September 1980. Baker, R.W.; Hewson, E.W. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Oct 1980. 122p. NTIS, PC A06/MF A01. Order Number DE81029291.

Tables and graphs are presented concerning monthly wind speed summaries; wind spectrum analyzer summaries; high wind speed summaries; six hourly speed and direction plots for selected wind power sites; wind flow plots in the Goodnoe Hills MOD-2 wind turbine area; and wind flow plots in the Goodnoe Hills and Juniper Point area.

30415 (SERI/TR—762-966) Wind power for developing nations. Mikhail, A. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1981. Contract AC02-77CH00178. 331p. NTIS, PC A15/MF A01. Order Number DE81025792.

This report is designed to assist engineers, energy planners in developing countries, and donor agencies' personnel to assess the global potential of wind energy conversion systems (WECS). The cost effectiveness of WECS mainly depends on the availability of the wind resource, system power performance, and the comparative cost of alternate energy sources. Therefore, this report presents an overview of the global wind resource including observed zonal

wind systems for each continent, available wind data, current wind maps, and on-going studies to assess the global wind potential. Also, because the most accurate method of assessing wind energy potential in a certain location is on-site measurement, the differences between commercially available wind sensors and recording equipments are discussed. A methodology is outlined for obtaining a match between machine and site characteristics for most cost-effective power production. The first three sections deal primarily with wind resource and wind-machine interaction. The final two sections cover wind machine technology and wind energy applications.

1704 Economics

REFER ALSO TO CITATION(S) 30425

1705 Environmental Aspects

REFER ALSO TO CITATION(S) 30430

30416 (SERI/CP—635-1238, pp 355-362) **Measured and calculated characteristics of wind turbine noise.** Greene, G.C. (Langley Research Center, Hampton, VA). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

This paper presents the results of an analytical and experimental investigation of wind turbine noise. Noise calculations indicate that for configurations with the rotor downwind of the support tower, the primary source of noise is the rapid change in rotor loading which occurs as the rotor passes through the tower wake. Noise measurements are presented for solid and truss-type tower models with both upwind and downwind rotors. Upwind rotor configurations are shown to be significantly quieter than downwind configurations. The model data suggest that averaged noise measurements and noise calculations based on averaged tower wake characteristics may not accurately represent the impulsive noise characteristics of downwind rotor configurations.

30417 (SERI/CP—635-1238, pp 375-387) **Acoustic noise generation by the DOE/NASA MOD-1 wind turbine.** Kelley, N.D. (Solar Energy Research Inst., Golden, CO). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The results of a series of measurements taken over the past year of the acoustic emissions from the DOE/NASA MOD-1 Wind Turbine has shown the maximum acoustic energy is concentrated in the low frequency range, often below 100 Hz. The temporal as well as the frequency characteristics of the turbine sounds have been shown to be important since the MOD-1 is capable of radiating both coherent and incoherent noise. The coherent sounds are usually impulsive and are manifested in an averaged frequency domain plot as large numbers of discrete energy bands extending from the blade passage frequency to beyond 50 Hz on occasion. It is these impulsive sounds which are identified as the principal source of the annoyance to a dozen families living within 3 km of the turbine. The source of the coherent noise appears to be the rapid, unsteady blade loads encountered as the blade passes through the wake of the tower structure.

30418 (SERI/CP—635-1238, pp 389-395) **GE MOD-1 noise study.** Wells, R.J. (General Electric Co., Schenectady, NY). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

Noise studies of the MOD-1 Wind Turbine Generator are summarized, and a simple mathematical model is presented which is adequate to correlate the sound levels found near the machine. A simple acoustic measure is suggested for use in evaluating far field sound levels. Use of this measure as input to a currently available sound complaint prediction program is discussed. Results of a recent statistical survey relative to the far field variation of this acoustic measure because of atmospheric effects are described.

30419 (SERI/CP—635-1238, pp 397-400) **Enhancement of far-field sound levels by refractive focusing.** Thomson, D.W.; Roth, S.D. (Pennsylvania State Univ., University Park). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The enhancement of sound pressure levels resulting from refractive focusing has been calculated for meteorological conditions representative of those observed at the MOD-1 site near Boone, NC. The results show that 10 to 20dB enhancements can occur over ranges of several hundred meters. Localized enhancements in excess of 20dB can occur but will probably be of limited duration as a consequence of normal temporally varying meteorological conditions.

30420 (SERI/CP—635-1238, pp 401-409) **Predictions of low-frequency and impulsive sound radiation from horizontal-axis wind turbines.** Martinez, R.; Widnall, S.E.; Harris, W.L. (Massachusetts Inst. of Tech., Cambridge). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

This paper develops theoretical models to predict the radiation of low-frequency and impulsive sound from horizontal-axis wind turbines due to three sources: (1) steady blade loads; (2) unsteady blade loads due to operation in a ground shear; (3) unsteady loads felt by the blades as they cross the tower wake. These models are then used to predict the acoustic output of MOD-1, the large wind turbine operated near Boone, NC. Predicted acoustic time signals are compared to those actually measured near MOD-1; good agreement is obtained.

30421 (SERI/CP—635-1238, pp 411-418) **The NASA-LeRC wind turbine sound prediction code.** Viterna, L.A. (Lewis Research Center, Cleveland, OH). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

Since regular operation of the DOE/NASA Mod-1 wind turbine began in October 1979 about 10 nearby households have complained of noise from the machine. Development of the NASA-LeRC wind turbine sound prediction code began in May 1980 as part of an effort to understand and reduce the noise generated by Mod-1. Tone sound levels predicted with this code are in generally good agreement with measured data taken in the vicinity Mod-1 wind turbine (less than 2 rotor diameters). Comparison in the far field indicates that propagation effects due to terrain and atmospheric conditions may be amplifying the actual sound levels by about 6 db. Parametric analysis using the code has shown that the predominant contributors to Mod-1 rotor noise are (1) the velocity deficit in the wake of the support tower, (2) the high rotor speed, and (3) off-optimum operation.

30422 (SERI/CP—635-1238, pp 419-423) **Noise generation of upwind rotor wind turbine generators.** Spencer, R.H. (Boeing Vertol Co., Philadelphia, PA). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

Noise sources of wind turbines with rotors upstream of the support structure are discussed along with methodology for sound level prediction. Estimated noise levels for the MOD-2 wind turbine are presented operating in both the upwind and downwind configurations. Results indicate that upwind rotor configurations may be advantageous from an acoustical standpoint.

30423 (SERI/CP—635-1238, pp 425-430) **Status report on downwind rotor horizontal axis wind turbine noise prediction.** Metzger, F.B.; Klatte, R.J. (United Technologies Corp., Windsor Locks, CT). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

NASA and industry are currently cooperating in the conduct of extensive experimental and analytical studies to understand and predict the noise of large, horizontal-axis wind turbines. This effort consists of (1) obtaining high quality noise data under well-

controlled and documented test conditions, (2) establishing the annoyance criteria for impulse noise of the type generated by horizontal-axis wind turbines with rotors downwind of the support tower, (3) defining the wake characteristics downwind at the axial location of the plane of rotation, (4) comparing predictions with measurements made by use of wake data, and (5) comparing predictions with annoyance criteria. This report briefly summarizes the status of work by Hamilton Standard in the above areas which was done in support of the cooperative NASA and industry studies.

30424 (SERI/CP—635-1238, pp 431-435) **Wind turbine acoustic standards.** Stephens, D.G.; Shepherd, K.P.; Grosveld, F. (Langley Research Center, Hampton, VA). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

A program is being conducted to develop noise standards for wind turbines which minimize annoyance and which can be used in design specifications. The approach consists of presenting wind turbine noise stimuli to test subjects in a laboratory listening chamber. The responses of the subjects are recorded for a range of stimuli which encompass the designs, operating conditions, and ambient noise levels of current and future installations. Results to date have established the threshold of detectability for a range of impulsive stimuli of the type associated with blade/tower-wake interactions. The status of the ongoing psychoacoustic tests, the subjective data, and the approach to the development of acoustic criteria/standards are described.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 30122, 30412, 30414, 30415, 30415

30425 **(DOE/CS/30278—T10) Solar technology assessment project. Volume VIII. Wind energy.** Hughes, W.L.; Ramakumar, R.G.; Lingelbach, D.D. (Oklahoma State Univ., Stillwater (USA). Engineering Energy Lab.; University of Central Florida, Orlando (USA). Florida Solar Energy Center). Apr 1981. Contract FC02-79CS30278. 143p. NTIS, PC A07/MF A01. Order Number DE81029009.

This paper first gives a brief historical perspective of wind energy utilization followed by a discussion of the potential uses (promises) of wind and the economic costs and technical difficulties (problems) of using it. A discussion of the statistical characteristics of the wind follows for a moderate to high wind area in the United States (actually, Oklahoma City data was used). Information on average available energy on an annual basis is presented, along with approximately monthly variations. There are an extensive variety of types of windmills in existance, and a sampling of these varieties is discussed briefly. Data on efficiencies and power coefficients for a variety of turbines is then presented. The remainder of the report generally is divided into a discussion of small (less than 100 kW) and large (larger than 100 kW) systems. Small systems and applications are discussed in some detail along with economic analyses.

30426 **(DOE/NASA/20320—32) Tests of an overrunning clutch in a wind turbine.** Seidel, R.C.; Pfanner, H.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1981. Contract AI01-76ET20320. 12p. (NASA-TM—82653). NTIS, PC A02/MF A01. Order Number DE81028493.

The report describes the tests that were run on an overrunning clutch, a concept being considered for use on advanced wind turbine designs. The overrunning clutch has potential to simplify operations and improve wind turbine performance in low and variable winds. The energy capture can be increased because, as the wind decreases, the wind turbine does not motor but is permitted to coast below synchronous speed. Also, as the wind speed increases, the rotor rpm increases to synchronous and produces power without requiring time for wind speed averaging or synchronization. The overrunning clutch was installed between the gearbox and the alternator. Overrunning clutches are mature mechanical devices made by a number of manufacturers and have rated life cycles consistent with a thirty year wind turine life.

30427 **(EPRI-AP—1959) Large wind turbine generator performance assessment. Technology status report No. 3. Interim report.** Vachon, W.A. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jul 1981. 136p. NTIS, PC A07/MF A01. Order Number DE81903763.

This report presents a summary of recent test data and experience from large wind turbine (WT) development and test programs funded by both the Federal Government and private enterprises. The data presented are current as of October 1980. Detailed summaries of test results are presented for the US Department of Energy's 200-kW MOD-0A horizontal-axis WTs that have been interconnected with electric utilities at various locations around the United States. A description of the progress and experiences with both the MOD-1 1.5-MW WT and the cluster of three MOD-2 2.5-MW WTs is also presented, along with a summary of plans for the DOE vertical-axis wind turbine program. A brief summary of Danish large WT programs is also provided.

30428 **(SAND—81-0923) Residual stresses in darrieus vertical axis wind turbine blades.** Veers, P. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1981. Contract AC04-76DP00789. 63p. NTIS, PC A04/MF A01. Order Number DE81026144.

A numerical package called RESID has been assembled to calculate the residual stresses in VAWT blades induced during cold forming. Using a strength of materials - elementary beam theory approach, RESID models the material response with a bilinear stress-strain curve, and the cross-sectional geometry with an array of area increments. Through an iterative solution procedure residual stresses are predicted for a specified final radius of curvature or applied bending moment. RESID results are compared to theoretical solutions for simple geometries and with MARC Finite element results for VAWT blade geometries. Calculating residual stress levels, determining acceptable residual stress levels, and a method of reducing residual stresses are discussed. A complete listing and sample run are included in the appendicies.

30429 **(SAND—81-0979) Aerodynamic sizing of vertical-axis wind turbines for wind farms.** Cole, J.K. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01. Order Number DE81029294.

This study addresses the issue of whether a large number of small turbines or a small number of large turbines will generate the most total power on a given wind farm. The effects of atmospheric boundary layer, turbine pedestal height, and turbine Reynolds number are evaluated for vertical-axis wind turbines (VAWTs) that are 17, 46, and 85 m in diameter. Results indicate that for realistic thicknesses of atmospheric boundary layers, increasing the size of the turbine increases the total power generated. Adding a pedestal may also increase the power generated. If the atmospheric boundary layer exceeds 100 m in thickness, a wind farm can generate up to 73% more power through the use of 85-m-dia VAWTs instead of 17-m-dia VAWTs.

30430 **(SERI/CP—635-1238) Wind turbine dynamics. NASA conference Publication 2185.** Thresher, R.W. (ed.). (Solar Energy Research Inst., Golden, CO (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; Oregon State Univ., Corvallis (USA)). 1981. Contract AC02-77CH00178. 433p. (CONF-810226—). NTIS, PC A19/MF A01. Order Number DE81027829.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The Second DOE/NASA Wind Turbine Dynamics Workshop was held in Cleveland, Ohio, February 24-26, 1981. Papers were presented on the dynamic behavior of large and small horizontal-axis and vertical-axis wind turbines. A total of 48 papers were contributed and are included in this proceeding. Contributors include universities, manufacturers, government laboratories, and private research organizations. The papers discuss a variety of topics including aerodynamics, structural dynamics, electrical system dynamics, control dynamics, and acoustics. Summaries of the informative discussions held at the workshop as well as the questions and answers which followed each paper are documented in the proceedings.

30431 (SERI/CP—635-1238, pp 3-7) **Aerodynamic potpourri.** Wilson, R.E. (Oregon State Univ., Corvallis). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

Aerodynamic developments for vertical axis and horizontal axis wind turbines are given that relate to the performance and aerodynamic loading of these machines. Included are: (1) a fixed wake aerodynamic model of the Darrieus vertical axis wind turbine; (2) experimental results that suggest the existence of a laminar flow Darrieus vertical axis turbine; (3) a simple aerodynamic model for the turbulent windmill/vortex ring state of horizontal axis rotors; and (4) a yawing moment of a rigid hub horizontal axis wind turbine that is related to blade coning.

30432 (SERI/CP—635-1238, pp 9-18) **Aerodynamic performance prediction of horizontal axis wind turbines.** Jeng, D.R.; Keith, T.G.; Aliakbarkhanafjeh, A. (Univ. of Toledo, OH). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The purpose of this work is to describe a new method for calculating the aerodynamic performance of horizontal axis wind turbines. The method, entitled the helical vortex method, directly calculates the local induced velocity due to helical vortices that originate at the rotor blade. Furthermore, the method does not require a specified circulation distribution. Results of the method are compared to similar results obtained from wilson PROP code methods (Prandtl, Goldstein, NASA and no tip loss) as well as to existing experimental data taken from the NASA Mod-0 wind turbine. It is shown that results of the proposed method agree well with experimental values of the power output both near cut-in and at rated wind speeds. Further, it is found that the method does not experience some of the numerical difficulties encountered by the PROP code when run at low wind velocities.

30433 (SERI/CP—635-1238, pp 19-25) **Double-multiple streamtube model for Darrieus wind turbines.** Paraschivoiu, I. (Institut de Recherche d'Hydro-Quebec, Varennes). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

An analytical model is proposed for calculating the rotor performance and aerodynamic blade forces for Darrieus wind turbines with curved blades. The method of analysis uses a multiple-streamtube model, divided into two parts: one modeling the upstream half-cycle of the rotor and the other, the downstream half-cycle. The upwind and downwind components of the induced velocities at each level of the rotor were obtained using the principle of two actuator disks in tandem. Variation of the induced velocities in the two parts of the rotor produces larger forces in the upstream zone and smaller forces in the downstream zone. Comparisons of the overall rotor performance with previous methods and field test data show the important improvement obtained with the present model. The calculations were made using the computer code CARDAA developed at IREQ.

30434 (SERI/CP—635-1238, pp 27-34) **UTRC wind energy conversion system performance analysis for horizontal axis wind turbines (WECSPER).** Egolf, T.A.; Landgrebe, A.J. (United Technologies Research Center, East Hartford, CT). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The theory for the UTRC Wind Energy Conversion System Performance Analysis (WECSPER) for the prediction of horizontal axis wind turbine performance is presented. Major features of the analysis are the ability to: (1) treat the wind turbine blades as lifting lines with a prescribed wake model; (2) solve for the wake-induced inflow and blade circulation using real nonlinear airfoil data; and (3) iterate internally to obtain a compatible wake transport velocity and blade loading solution. This analysis also provides an approximate treatment of wake distortions due to tower shadow or wind shear profiles. Finally, selected results of internal UTRC application of the analysis to existing wind turbines and correlation with limited test data are described.

30435 (SERI/CP—635-1238, pp 35-40) **Velocity field of a system of unsteady cycloidal vorticies.** Young, B.J. (Young Energy Systems, Dennisport, MA). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

An essential difference between two-dimensional and three-dimensional models of cycloidal rotors is the presence of unsteady trailing cycloidal vorticies in the wake. The velocity induced by these vorticies is the primary mechanism producing flow retardation for low span/radius ratio, finite blade number rotors. An idealized rigid wake model of finite blade cycloidal rotors is used to investigate some cycloidal rotor problems.

30436 (SERI/CP—635-1238, pp 41-49) **Analytical studies of new airfoils for wind turbines.** Wentz, W.H. Jr. (Wichita State Univ., KS); Calhoun, J.T. 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

Computer studies have been conducted to analyze the potential gains associated with utilizing new airfoils for large wind turbine rotor blades. Attempts to include 3-dimensional stalling effects are inconclusive. It is recommended that blade pressure measurements be made to clarify the nature of blade stalling. It is also recommended that new NASA laminar flow airfoils be used as rotor blade sections.

30437 (SERI/CP—635-1238, pp 51-66) **Wake of a Darrieus turbine.** Base, T.E.; Phillips, P.; Robertson, G.; Nowak, E.S. (Univ. of Western Ontario, London). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The theory and experimental measurements on the aerodynamic decay of a wake from high performance vertical axis wind turbine will be discussed. In the initial experimental study, the wake downstream of a model Darrieus rotor, 28 cm diameter and a height of 45.5 cm, was measured in the University Boundary Layer Wind Tunnel. The wind turbine was run at the design tip speed ratio of 5.5. It was found that the wake decayed at a slower rate with distance downstream of the turbine, than a wake from a screen with similar troposkein shape and drag force characteristics as the Darrieus rotor. The initial wind tunnel results indicated that the vertical axis wind turbines should be spaced at least forty diameters apart to avoid mutual power depreciation greater than ten percent.

30438 (SERI/CP—635-1238, pp 79-86) **Performance of wind turbines in a turbulent atmosphere.** Sundar, R.M.; Sullivan, J.P. (Purdue Univ., West Lafayette, IN). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The effect of atmospheric turbulence on the power fluctuations of large wind turbines is studied. The significance of spatial non-uniformities of the wind is emphasized. The turbulent wind with correlation in time and space is simulated on the computer by Shinozukas method. The wind turbulence is modelled according to the Davenport spectrum with an exponential spatial correlation function. The rotor aerodynamics is modelled by simple blade element theory. Comparison of the spectrum of power output signal between 1-D and 3-D turbulence, shows the significant power fluctuations centered around the blade passage frequency.

30439 (SERI/CP—635-1238, pp 87-99) **Wind response characteristics of horizontal axis wind turbines.** Thresher, R.W.; Holley, W.E.; Jafarey, N. (Oregon State Univ., Corvallis). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

It was the objective of the work reported to take a broader look at wind turbine dynamic response to turbulence, and attempt to ascertain the features of turbulence that wind turbines are most sensitive to. A statistical description of the wind input including all three wind components and allowing linear wind gradients across

the rotor disk, was used together with quasi-static aerodynamic theory and an elementary structural model involving only a few degrees of freedom. The idea was to keep the turbine model simple and show the benefits of this type of statistical wind representation before attempting to use a more complex turbine model. As far as possible, the analysis was kept in the simplest form, while still preserving key physical responses.

30440 (SERI/CP—635-1238, pp 101-112) **Wind turbulence inputs for horizontal axis wind turbines.** Holley, W.E.; Thresher, R.W.; Lin, S.R. (Oregon State Univ., Corvallis). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

In order to predict wind turbine response characteristics in the presence of atmospheric turbulence, two major modeling steps are required. First, the important atmospheric sources for the force excitations felt by the wind turbine system must be identified and characterized. Second, a dynamic model must be developed which describes how these excitations are transmitted through the structure and power train. The goal of this paper is to establish the first modeling step, that of quantifying the important excitations due to the atmospheric turbulence.

30441 (SERI/CP—635-1238, pp 113-120) **Applications of the DOE/NASA wind turbine engineering information system.** Neustadter, H.E.; Spera, D.A. (Lewis Research Center, Cleveland, OH). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The NASA Lewis Research Center manages for the Department of Energy, the technology and engineering development of large horizontal axis wind turbines. In support of this activity each wind turbine has a variety of information systems used to acquire, process and analyze data. In general four categories of data systems, each responding to a distinct information need, can be identified. The categories are: Control, Technology, Engineering and Performance. The focus of this report is on the information that can be extracted by statistical analysis of data obtained from the Technology and Engineering Information Systems. These systems consist of the following elements: (1) sensors which measure critical parameters (e.g., wind speed and direction, output power, blade loads and component vibrations; (2) remote multiplexing units (RMUs) on each wind turbine which frequency-modulate, multiplex and transmit sensor outputs; (3) on-site instrumentation to record, process and display the sensor output; and (4) statistical analysis of data at the NASA-Lewis Research Center in Cleveland, Ohio. Two examples of the capabilities of these systems are presented.

30442 (SERI/CP—635-1238, pp 121-128) **Overview of fatigue failures at the Rocky Flats wind system test center.** Waldon, C.A. (Rockwell International, Golden, CO). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

This paper is intended to identify potential SWECS design problems and thereby improve product quality and reliability. Mass produced components such as gearboxes, generators, bearings, etc., are generally reliable due to their widespread uniform use in other industries. The likelihood of failure increases, though, in the interfacing of these components and in SWECS components designed for a specific system use. Problems relating to the structural integrity of such components are discussed and analyzed in this report with techniques currently used in quality assurance programs in other manufacturing industries.

30443 (SERI/CP—635-1238, pp 129-138) **Performance testing of a 50 kW VAWT in a built-up environment.** Schienbein, L.A. (DAF Indal Ltd., Mississauga, Ontario). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The results of performance tests of a DAF Indal 50 kW vertical axis wind turbine carried out at the Company's plant near Toronto, Canada, are presented. Results of limited free stream turbulence and vertical wind shear measurements at the site are also presented. The close agreement between measured and predicted energy outputs, required to verify the wind turbine power output performance relationship, was not attained. A discussion is presented of factors that may have contributed to the lack of better agreement.

30444 (SERI/CP—635-1238, pp 139-150) **Calculation of guaranteed mean power from wind turbine generators.** Spera, D.A. (Lewis Research Center, Cleveland, OH). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

Much research has been devoted to the nominal power generated by wind machines, but little work has been done on the subject of guaranteed power. Yet power guarantees will be part of the commercialization of wind energy systems. This paper describes in step-by-step fashion a proposed method for calculating the guaranteed mean power output of a wind turbine generator. The term mean power as used in this study refers to the average power generated at specified wind speeds during short-term tests. Extrapolation to an annual mean power, based on wind statistics, is beyond the scope of this paper. Guaranteed energy is not addressed. The DOE/NASA Mod-OA 200 kW plant in Clayton, New Mexico, is used as a sample case. Subjects discussed and illustrated are correlation of anemometers, the method of bins for analyzing non-steady data, the PROP Code for predicting turbine power, and statistical analysis of deviations in test data from theory. Guaranteed mean power density for the Clayton Mod-OA system was found to be 8 watts per square meter less than theoretical power density at all power levels, with a confidence level of 0.999. This amounts to 4 percent of rated power.

30445 (SERI/CP—635-1238, pp 151-154) **Hydraulic windmill.** Browning, J.A. (Browning Engineering Corp., Hanover, NH). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The hydraulic windmill pumps pressurized oil from rotor shaft level to the ground where a motor-generator produces electricity. Alternatively, the useful output may be heat. Rotor speed is governed by a flow valve. Over pressure, the result of high wind velocity, rotates the tail to move the rotor blades out-of-the-wind. Loss of oil pressure causes a brake to close as well as to swing the tail to its maximum distance from the rotor plane.

30446 (SERI/CP—635-1238, pp 155-161) **Two-dimensional turbulence models.** Frost, W.; Lin, M.C. (Univ. of Tennessee, Tullahoma). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

Two-dimensional turbulence models described in the NASA technical paper 1359, Engineering Handbook on the Atmospheric and Environmental Guidelines for Use in Wind Turbine Generator Development, are compared with experimental measurements made using an array of instrumented towers. Discussion of the spatial correlation coefficient, the two-point spectrum or cross spectrum, and the coherence function is given. The prediction techniques in general agree reasonably well with the experimental results. Measurements of the integral length scale however, do not correlate well with the prediction model recommended in the design handbook.

30447 (SERI/CP—635-1238, pp 165-172) **Review of analysis methods for rotating systems with periodic coefficients.** Dugundji, J.; Wendell, J.H. (Massachusetts Inst. of Tech., Cambridge). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The present article reviews two of the more common procedures for analyzing the stability and forced response of equations with periodic coefficients, namely, the use of Floquet methods, and the use of multiblade coordinate and harmonic balance methods. The analysis procedures of these periodic coefficient systems are compared with those of the more familiar constant coefficient systems.

30448 (SERI/CP—635-1238, pp 173-176) **Approximate method for solution to variable moment of inertia problems.** Beans, E.W. (Univ. of Toledo, OH). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The weathering vaning motion of a wind turbine with a moving rotor is an oscillatory problem with a variable moment of inertia. The analysis of such a motion requires the solution of a non-linear differential equation. In this article an approximation method is presented for reducing the problem to an equivalent constant moment of inertia problem. The method is based on the assumption that a moving rotor is an integrator and, therefore, the problem willl behave as if it has an averaged moment of inertia. It is further assumed that this will be a valid solution to the problem if the rotating speed of the wind turbine is infinite. The method consists of determing the integrated average of the moment of inertia for a single rotation. This averaged value can then be used to determine equivalent natural frequency of the system and other dynamic properties.

30449 (SERI/CP—635-1238, pp 177-187) **Computation of the modes and polar moment of inertia of the blades of an HAWT.** Beaulieu, G.; Noiseux, D. (Inst. de Recherche d'Hydro-Quebec (IREQ), Varennes). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The numerical solution of the coupled differential equations of motion of the blades of a horizontal axis wind turbine is a more direct approach than the technique of finite elements, permitting the optimization of the design at relatively low cost. The procedure consists in transforming the equation of motion into a set of first order equations and solving them with fourth order Runge-Kutta integrators. This technique is applied to a twisted, tapered blade of variable cross section and stiffness including discontinuities. The first six natural frequencies and mode shapes are obtained. This technique is extended to obtain the polar moment of inertia of the blades as a function of frequency and rotational speed.

30450 (SERI/CP—635-1238, pp 199-200) **Flutter of Darrieus wind turbine blades: correlation of theory and experiment.** Ham, N.D. (Massachusetts Inst. of Tech., Cambridge). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

Acquisition of frequency data for the Alcoa 17-M LC and 1238229 wind turbines has permitted some limited correlation of flutter analysis with experimental data for flutter of Darrieus blades.

30451 (SERI/CP—635-1238, pp 201-210) **Whirl flutter analysis of a horizontal-axis wind turbine with a two-bladed teetering rotor.** Janetzke, D.C. (Lewis Research Center, Cleveland, OH); Kaza, K.R.V. 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

An investigation to explore the possibility of whirl flutter and to find the effect of pitch-flap coupling (δ_3) on teetering motion of the DOE/NASA Mod-2 wind turbine is presented. The equations of motion are derived for an idealized five-degree-of-freedom mathematical model of a horizontal-axis wind turbine with a two-bladed teetering rotor. The model accounts for the out-of-plane bending motion of each blade, the teetering motion of the rotor, and both the pitching and yawing motions of the rotor support. Results show that the Mod-2 design is free from whirl flutter. Selected results are presented indicating the effect of variations in rotor support damping, rotor support stiffness, and δ_3 on pitching, yawing, teetering, and blade bending motions.

30452 (SERI/CP—635-1238, pp 211-219) **Wind energy system time-domain (WEST) analyzers.** Dreier, M.E.; Hoffman, J.A. (Paragon Pacific, Inc., El Segundo, CA). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

Using the latest hybrid electronics technology, a portable analyzer which simulates in real time the complex nonlinear dynamics of horizontal axis wind energy systems has been constructed. Math models for an aeroelastic rotor featuring nonlinear aerodynamic and inertial terms have been implemented with high speed digital controllers and analog calculation; this rotor model is then combined with other math models of elastic supports, control systems, a power train and gimballed rotor kinematics. The analyzer also features a stroboscopic display system graphically depicting distributed blade loads, motion, and other aerodynamic functions on a cathode ray tube. The viewer sees a clear picture of rotor dynamics in the start-up, shut-down, and trim states, as well as operation in special transient conditions such as gust and emergency shutdown.

30453 (SERI/CP—635-1238, pp 221-223) **Experience on the use of MOSTAB-HFW computer code for horizontal-axis wind turbines.** Yu, Y.Y. (Rockwell International, Canoga Park, CA). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

Experience gained from the dynamic analysis of horizontal axis turbine rotors based on the use of the MOSTAB-HFW computer code is described. Three topics are covered, dealing with the frequencies of a rotating beam, the use of the fundamental mode of a uniform cantilever beam, and the analysis of resonance dwell. Immensely high peak loads were generated by the code for resonance dwell, indicating further need for including structural damping and for transient analysis capability. The effect of structural damping, newly incorporated in the code, is finally described.

30454 (SERI/CP—635-1238, pp 237-244) **Review of resonance response in large, horizontal-axis wind turbines.** Sullivan, T.L. (Lewis Research Center, Cleveland, OH). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

Field operation of the Mod-0 and Mod-1 wind turbines has provided valuable information concerning resonance response in large, two-bladed, horizontal axis wind turbines. Operational experience has shown that 1 per rev excitation exists in the drive train, high aerodynamic damping prevents resonance response of the blade flatwise modes and teetering the hub substantially reduces the chordwise blade response to odd harmonic excitation. These results can be used by the designer as a guide to system frequency placement. In addition it has been found that present analytical techniques can accurately predict wind turbine natural frequencies.

30455 (SERI/CP—635-1238, pp 245-253) **SWECS tower dynamics analysis methods and results.** Wright, A.D. (Rockwell International, Golden, CO); Sexton, J.H.; Butterfield, C.P.; Thresher, R.W. 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

At the Rocky Flats Wind Systems Center, several different tower dynamics analysis methods and computer codes are used to determine the natural frequencies and mode shapes of both guyed and freestanding wind turbine towers. These analysis methods are described and the results for two types of towers: a guyed tower and a freestanding tower are shown. The advantages and disadvantages in the use of and the accuracy of each method are also described.

30456 (SERI/CP—635-1238, pp 265-270) **North Wind 4kW passive control system design.** Currin, H. (Foehn Consulting, Klamath Falls, OR). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

An overview of a mechanical rotor control design is presented. Operation at constant RPM and rapid response are obtained by using blade pitch moments for both sensing control need and blade pitch actuation. The basic concept, static or equilibrium design, and dynamic analysis are briefly presented.

30457 (SERI/CP—635-1238, pp 271-275) **Passive cyclic pitch control for horizontal axis wind turbines.** Bottrell, G.W. (Ventus Energy Corp., La Crescenta, CA). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

A new flexible rotor concept, called the balanced-pitch rotor, is described. The system provides passive adjustment of cyclic pitch in response to unbalanced pitching moments across the rotor disk. Various applications are described and performance predictions are made for wind shear and cross wind operating conditions. Comparisons with the teetered hub are made and significant cost savings are predicted.

30458 (SERI/CP—635-1238, pp 277-286) **Dynamics of an experimental two bladed horizontal axis wind turbine with blade cyclic pitch variation.** Hohenemser, K.H.; Swift, A.H.P. (Washington Univ., St. Louis, MO). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The horizontal axis wind turbine under study incorporates the combination of two features: the application of blade cyclic pitch variation and the use of yaw angle control for rotor speed and torque regulation. Due to its emasculation by passive cyclic pitch variation the rotor can be rapidly yawed without encountering gyroscopic and aerodynamic hub moments and without noticeable out-of-plane blade excursions. The two bladed upwind rotor is vane stabilized and of very simple and rugged design. The principle was first checked out with a small scale wind tunnel model and then tested in the atmosphere with a 7.6 meter diameter experimental fully instrumented wind turbine driving a 3 phase alternator. The rotor to tail vane furl angle was controlled through an electric actuator by a manually operated toggle switch overridden by an automatic rotor overspeed relay. The paper summarizes the test results with respect to structural dynamics and yaw dynamics.

30459 (SERI/CP—635-1238, pp 287-293) **MOD-0 wind turbine dynamics test correlations.** Brooks, B.M. (Hamilton Standard, Windsor Locks, CT). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The behavior of the teetered, downwind, free yaw, MOD-0 wind turbine, as represented by NASA dynamic test data, was used to support confidence in the Hamilton Standard computer code simulations. Trim position, performance at trim, and teeter response as predicted by the computer codes were compared to test results. Using the computer codes, other possible configurations for MOD-0 were investigated. Several new test configurations are recommended for exploring free yaw behavior. It is shown that eliminating rotor tilt and optimizing coning and blade twist can contribute to good free yaw behavior and stability. The effects of rotor teeter, teeter gravity balance, inflow and other physical and operating parameters were also investigated.

30460 (SERI/CP—635-1238, pp 295-301) **Effect of δ_3 on a yawing HAWT blade and on yaw dynamics.** Perkins, F.W.; Jones, R. (Kaman Aerospace Corp., Bloomfield, CT). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

A single degree of freedom aeroelastic computer model, WMSTAB3, has been employed to perform a parametric analysis of HAWT blade behavior during yaw maneuvers. Over 1000 different combinations of δ_3 and normal frequency were analyzed. The effect of δ_3 and flapping stiffness on flapping frequency, phase, and magnitude are discussed. The moments transmitted to the fixed system during yaw maneuvers are calculated and reduced to time constants of response to step changes in wind direction. The significance of the time constants for the configurations considered relative to yaw response rate and lag angle is discussed, along with their possible significance for large HAWT.

30461 (SERI/CP—635-1238, pp 315-323) **Dynamics and stability of wind turbine generators.** Hinrichsen, E.N.; Nolan, P.J. (Power Technologies, Inc., Schenectady, NY). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

This paper describes the dynamic and stability properties of wind turbine generators connected to power systems. Both synchronous and induction generators are considered. A comparison is made between wind turbines, steam, and hydro units. The unusual phenomena associated with wind turbines are emphasized. The general control requirements are discussed, as well as various schemes for torsional damping such as speed sensitive stabilizer and blade pitch control. Interaction between adjacent wind turbines in a wind farm is also considered.

30462 (SERI/CP—635-1238, pp 325-332) **Kaman 40 kW wind turbine generator: control system dynamics.** Perley, R. (Kaman Aerospace Corp., Bloomfield, CT). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The Kaman 40 kW Wind Turbine Generator design incorporates an induction generator for applications where a utility line is present and a synchronous generator for standalone applications. A combination of feed forward and feedback control is used to achieve synchronous speed prior to connecting the generator to the load, and to control the power level once the generator is connected. The dynamics of the drive train affect several aspects of the system operation. These have been analyzed to arrive at the required shaft stiffness. The rotor parameters that affect the stability of the feedback control loop vary considerably over the wind speed range encountered. Therefore, the controller gain was made a function of wind speed in order to maintain consistent operation over the whole wind speed range.

30463 (SERI/CP—635-1238, pp 343-352) **Effect of wind turbine generator model and siting on wind power changes out of large WECS arrays.** Schlueter, R.A.; Park, G.L.; Lotfalian, M.; Dorsey, J.; Shayanfar, H. (Michigan State Univ., East Lansing). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

This paper discusses methods of reducing the WECS generation change through selection of the wind turbine model for each site, selection of an appropriate siting configuration, and wind array controls. An analysis of wind generation change from an echelon and a farm for passage of a thunderstorm is presented to establish the factors concerning the wind turbine model and siting configuration that contribute to these variations. Detailed simulation results indicate more precisely how these factors can be exploited to minimize the WECS generation changes observed. Reduction of the wind generation change over ten minutes is shown to reduce the increase in spinning reserve, unloadable generation and load following requirements on unit commitment when significant WECS generation is present and the farm penetration constraint is satisfied. Controls on the blade pitch angle of all wind turbines in an array or a battery control are shown to reduce both the wind generation change out of an array and the effective farm penetration in anticipation of a storm so that the farm penetration constraint may be satisfied.

30464 (SERI/CP—635-1238, pp 363-373) **Dynamics of wakes downstream of wind turbine towers.** Snyder, M.H.; Wentz, W.H. Jr. (Wichita State Univ., KS). 1981. NTIS, PC A19/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

The near-field wakes downstream of circular cylinders and of 12-sided cylinders were surveyed in a wind tunnel. Local velocity and velocity deficit diagrams are presented. The variation of turbulence in the wake was surveyed and the frequency of the periodic component of wake motion was determined. Differences between wakes of circular cylinders and of 12-sided cylinders are discussed. Also effects of strakes, orientation of the 12-sided cylinders, and rounding of the corners are noted.

30465 **Velocity and temperature oscillations in drainage winds.** Doran, J.C.; Horst, T.W. (Pacific Northwest Laboratory, Richland, Washington 99352). DE-AC06-76RLO1830. *Journal of Applied Meteorology ;* **20**: No. 4, 361-376(Apr 1981).

Spectra of the time series of wind speeds and temperatures measured in the outflow area of a large drainage region are presented. Peaks are found in these spectra at frequencies corresponding to periods of oscillation of ~1.5 h. A simple model is given, which accounts quanlitatively for some of the observed features.

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30466 **(ANL/CEN/FE—80-19) Influence of salts on the sulfur retention of limestone in atmospheric fluidized-bed combustors.** Smith, G.W.; Lenc, J.F.; Shearer, J.A.; Chopra, O.K.; Myles, K.M.; Johnson, I. (Argonne National Lab., IL (USA)). Jun 1981. Contract W-31-109-ENG-38. 39p. NTIS, PC A03/MF A01. Order Number DE81028473.

Increased utilization of the available CaO can reduce the amount of limestone required for SO_2 retention in atmospheric fluidized-bed combustion systems. In laboratory experiments, a pretreatment with inorganic salts, such as NaCl, $CaCl_2$, or Na_2CO_3, has been found to be an effective method of improving the CaO utilization. This report provides quantitative information on the effectiveness of the same sulfation-enhancement salts in reducing the limestone requirements in an atmospheric fluidized-bed combustor (AFBC). Some laboratory experiments indicated that only 0.1 mol % of salt was required to produce the structural changes in the limestone necessary to increase the CaO utilization. In contrast, the AFBC runs indicated that as much as 2.0 mol % salt was required to obtain a significant increase in the CaO utilization. The increased utilization of the salt-treated limestone in the AFBC reduced the total amount of limestone needed to meet the EPA emission standard for sulfur dioxide to one-half of that required when no treatment is used.

30467 **(ANL/CEN/FE—81-4) Cyclone performance estimates for pressurized fluidized-bed combustion.** Henry, R.F.; Podolski, W.F. (Argonne National Lab., IL (USA)). Jul 1981. Contract W-31-109-ENG-38. 33p. NTIS, PC A03/MF A01. Order Number DE81028504.

Hot pressurized flue gas from pressurized fluidized-bed combustion must be cleaned up prior to its expansion in a gas turbine as part of the combined-cycle electric power generation concept. The performance of conventional cyclones in experimental tests has been compared with theory, with reasonable agreement. Prediction of the performance of a larger cyclone system shows that three stages should provide the cleanup required on the basis of current estimates of turbine tolerance of particulate matter. Advances in hot gas cleanup - optimized cyclones, augmented cyclones, and alternative devices - should provide future improvement in cycle efficiencies and costs, but simple cyclones are planned for first-generation PFB/CC pilot and demonstration plants.

30468 **(ANL/CEN/FE—81-5) Alkali metal vapor removal from pressurized fluidized-bed combustor flue gas. Quarterly report, January-March 1981.** Johnson, I.; Lee, S.H.D. (Argonne National Lab., IL (USA)). Jun 1981. Contract W-31-109-ENG-38. 28p. NTIS, PC A03/MF A01. Order Number DE81028477.

In the application of pressurized fluidized-bed combustion (PFBC) to the generation of electricity, hot corrosion of the gas turbine (downstream from the combustor) by alkali metal compounds in the combustion gas is a potential problem. The objective of this investigation is to develop a method for the removal of gaseous alkali metal compounds from the high-pressure high-temperature gas from a PFBC before the gas enters the turbine. The use of a granular-bed filter for gas cleanup, utilizing activated bauxite as the bed material, is under study. Data are reported on the removal of gaseous NaCl from hot (800°C), pessurized (5 atm), wet (3.4% H_2O) simulated flue gas using activated bauxite. Greater than 99.9% NaCl vapor capture was achieved. The energy needed for the operation of a fixed granular-bed filter has been estimated. The energy needs and cost of using activated bauxite in the once-through and regeneration modes of operation are compared.

30469 **(DOE/ER/10766—3) Mitigation of biofouling using coatings. Quarterly progress report No. 3.** Meyer, A.E.; King, R.W. (Calspan Advanced Technology Center, Buffalo, NY (USA)). 22 Jun 1981. Contract AC02-80ER10766. 13p. NTIS, PC A02/MF A01. Order Number DE81027900.

Progress is reported in a project in which the objectives are to evaluate benefits associated with control of the surface energetic properties of materials used in heat exchangers, and to identify preferred ranges of these surface conditions that minimize deposits of biological fouling known to deteriorate heat exchange efficiencies in seawater, brackish water and freshwater systems. The technical approach employed uses special diagnostic plates in novel flow cells where fluid flow conditions can be well-controlled, modifying the surface chemistry and surface energy of the plates with very thin coatings and examining the earliest events of biofouling caused by macromolecules and microbial organisms. Information is included on exposure experiments and results and heat exchange experiments.

30470 **(DOE/ET/33024—1) Aerodynamic design problems of dry cooling systems.** Moore, F.K. (Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering). 1980. Contract AS02-76ET33024. 47p. NTIS, PC A03/MF A01. Order Number DE81027331.

Activities in a program which began in 1976 and concluded in 1979 for collecting and analyzing the effects of wind and inversions on natural draft cooling tower design are reviewed. Publications which resulted from the program are listed. Two complete papers, entitled Aerodynamic Design Problems of Dry Cooling Systems and Aerodynamic Losses of Highly Flared Natural Draft Cooling Towers, are included. (LCL)

30471 **(EPRI-AP—1882-Vol.2) Baseline data on utilization of low-grade fuels in gas turbine applications. Volume 2. Hot component corrosion evaluation. Final report.** Vitello, J.J.; Scheirer, S.T. (Westinghouse Electric Corp., Concordville, PA (USA)). Jun 1981. 64p. NTIS, PC A04/MF A01. Order Number DE81903760.

EPRI Project RP1079-2 was established to compare the corrosion of turbine parts when operated with residual oil versus distillate oil. A metallographic evaluation of combustion turbine hot components, which showed partial residual versus total distillate fuel firing, revealed no discernable differences in component degradation (hot corrosion). Considering the time of operation, the degree of hot corrosion observed was somewhat greater than expected for oil-fired combustion turbines of similar designs and alloy selections. This abnormality was attributed to the ingestion of high levels of sodium contaminated mist from the adjacent cooling tower through the turbine compressor inlet. Corrosion due to vanadium compounds in the heavy fuel machines was practically nil, which indicates that residual fuel is satisfactory for use in combustion turbine plants.

30472 **(EPRI-AP—1882-Vol.3) Baseline data on utilization of low-grade fuels in gas turbine applications. Volume 3. Emissions evaluation. Final report.** Sonnichsen, T. (KVB, Inc., Irvine, CA (USA)). Jun 1981. 108p. NTIS, PC A06/MF A01. Order Number DE81903764.

A series of field tests was conducted on two residual-oil-fired gas turbine/heat recovery steam generators (HRSG) comprising a Westinghouse PACE 260-MW combined-cycle unit. The objective of these tests was to determine base load emission levels (1) with and without afterburners in service, (2) with and without water injection, and (3) following a turbine wash. A brief series of tests was also made at reduced operating loads. Emission measurements included (1) gaseous constituents measured by continuous monitoring instrumentation (O_2, CO_2, NO, NO/sub x/, and SO_2) and by wet chemistry methods (SO_3, aldehydes, and chlorides) and (2) particulate characteristics (mass loading, smoke spot number,

submicron particle size, and particle morphology). Corrected NO/sub x/ emissions at base load were 170 ppM (690 lb/h) and 200 ppM (625 lb/h) with and without HRSG afterburners in service, respectively. NO/sub x/ emissions decreased with water injection by 50% and were unchanged with the turbine wash. NO/sub x/ increased with load. Particulate mass loading at the HRSG stack (EPA Method 5) increased from 0.05 lb/10^6 Btu to 0.08 lb/10^6 Btu with the use of supplemental firing during non-sootblowing periods. Operation with sootblowing significantly increased these levels. CO emissions and smoke spot numbers were low for all test conditions, increasing slightly with afterburner firing, water injection, and reduced load. SO_3 and aldehyde emissions were less than 1 ppM for all tests.

30473 **(EPRI-CS—1896) On-line acoutic-emission monitoring of fossil power plants: a critical assessment. Final report.** Leaver, D.E.; Harris, D.O. (Science Applications, Inc., Palo Alto, CA (USA)). Jun 1981. 107p. NTIS, PC A06/MF A01.

Acoustic emission technology as it applies to the incipient failure detection of fossil plant components is reviewed. Studies were made of the potential application fo acoustic emissions to the detection of failures of rotating shaft systems: turbine generators, pumps, fans, and compressors. Particularly of interst in this review was the early detection of cracks in the turbine generator shaft. Also studied was the use of acoustic monitoring techniques for heat exchanger tube leaks, particularly water walls, superheaters, reheaters, and feedwater heaters. Each potential application is rated as to its payoff and its probability of success. Recommended R & D plans are presented for those areas which offer good chance of success and high payoff. An important conclusion of this work is that monitoring of turbine shaft cracking is possible and desirable, although an optimum system may require rotating sensors in the bore and telemetry signals to transfer the ultrasonic signals to the stationary environment. Acoustic monitoring of the tube leaks in high-pressure water or steam systems, such as water walls, superheaters, and feedwater heaters, is also perceived to be a viable and valuable technique.

30474 **(EPRI-CS—1927) Failure-cause analysis: air preheaters. Final report.** Maloney, K.L.; Benson, R.C. (KVB, Inc., Irvine, CA (USA)). Jul 1981. 169p. NTIS, PC A08/MF A01. Order Number DE81903777.

This final report under RP1265-8 is one of several surveys being conducted through the Fossil Plant Performance and Reliability Program to define more clearly the major generic equipment and/or operating problems responsible for utility power plant outages. This survey includes input from 40 US utilities encompassing 118 generating units with an average size over 500 MW and using 236 air heaters. Data analysis resulting from this study clearly demonstrates problems with air preheater systems and their components that contribute to loss in performance and unavailability of generating units. Nine major problem areas are identified: corrosion, fouling, plugging, soot blowers, water wash system, seals, fires, and drive and bearing systems. The indicated causes and effects are discussed. Recommendations are made to improve the reliability of existing air preheaters, and generic problems requiring future research and application of existing technologies are identified. It is also recommended that users place more emphasis on the initial procurement phase to specify those design features that improve reliability. Another recommendation is to encourage manufacturers to accelerate their efforts to improve the technology and correct critical problems by upgrading their designs. Implementation of the recommendations included in this report by users and manufacturers can substantially improve the availability of air preheaters.

30475 (EPRI-WS—79-238-Vol.2, pp 32.1-32.12) **Gas turbines for future coal-based power generation systems.** Hefner, W.J.; Carlstrom, L.A. May 1981. NTIS, PC A19/MF A01.

In Conference proceedings: synthetic fuels-status and directions. Volume 2: sections 18-appendixes.

We have stressed the experience which we have had with the fuels of the past; petroleum derivatives, natural gas and a number of process hydrocarbon gases. This is the base of experience from which we gas turbine designers must work. While our experience gives us confidence in approaching the synthetic fuels future it by no means gives us ready made solutions. And while the anticipated problems of some synthetic fuels do not initimidate us, they keep us cautious of the limits of nature within which we must work. The achievement of widespread use of synthetic fuels, nationally or worldwide will have to be a cooperative effort. It must include those that develop the fuel processing techniques, those that design the machines that burn the fuels, those that use these machines for power generation, and the public agencies who establish the guidelines and support of these activities. The gas turbine industry has shown resourcefulness in the past in adapting to the use of a variety of fuels, both natural and manufactured. However, there are limits in the ability and practicality of burning some poor grade fuels with corrosive contaminants, ash forming constituents, and emission forming compounds. It will be in our mutual best interest to maintain an effective dialogue among gas turbine manufacturers, synthetic fuel process developers, the utility and industry users and the government agencies to promote developments in the best interest of the consumer public.

30476 (EPRI-WS—80-136, pp 19.1-19.16) **Failures modes in model feedwater heater tubing.** Williams, D.N.; Jackson, C.M. (Battelle Memorial Inst., Columbus, OH). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

Steam extracted from the turbine is used to preheat the boiler feedwater in fossil-fuel-fired steam plants in order to improve thermal efficiency. This is accomplished in a series of heaters between the condenser hot well and the boiler. The heaters usually consist of a shell containing a bundle of U-bend tubes through which the feedwater is circulated. The heaters closest to the boiler handle water at high pressure and temperature. Because of the severe service conditions, high-pressure feedwater heaters are frequently tubed with drawn-and-stress relieved Monel 400, a nickel-base alloy containing 35 percent copper. As part of a study designed to reduce the rate of tube failure in high-pressure feedwater heaters, a number of failed drawn-and-stress-relieved Monel 400 U-bend tubes removed from three high-pressure feedwater heaters were examined at Battelle to determine the causes of failure. The results of this examination are described.

30477 (EPRI-WS—80-141, pp 2.1-2.19) **Design features of the Kwinana oil to coal conversion.** Kregg, D.H. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

The Kwinana power plant in Western Australia is comprised of six generating units; four are rated at 100MW(e) each and two are rated at 200 MW(e) nameplate each. The latter two have been converted from oil firing to a dual oil/coal firing mode whereby 100% pulverized coal is fired during periods of low demand (< 60% MCR) and 100% oil is fired during high demand periods (60% to 100% MCR). This paper will describe the 1) feasibility study investigations that occurred when the conversion was under consideration by the utility owner/operator (SECWA), 2) the design features of the modified boiler plant, and, 3) the site modifications to receive and store coal.

30478 (EPRI-WS—80-141, pp 3.1-3.36) **Kwinana coal conversion in western Australia.** Kirkwood, J.B.; Chatfield, D.R. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

The State Energy Commission of Western Australia (SECWA) is responsible for the generation and transmission of electricity and gas throughout the State of Western Australia. In 1975 the largest power station of their system was the Kwinana Power Station consisting of (4) 120 MW units and with (2) 200 MV units under construction. All of these units were designed for oil/gas firing. In 1975 the commission decided to convert the (2) 200 MW units to dual coal/oil firing for an estimated cost of 26 million dollars at 1975 dollar levels. The project was successfully completed within the budget estimate by April 1979 and the operational experience with both units has been entirely satisfactory. The paper describes the background to the conversion decision, discusses the various design modifications necessary to convert the boiler and to provide coal handling facilities to the plant. The latest information

concerning the plant operation is provided. As a result of this successful project, SECWA has decided to convert a further 2 x 120 MW units to dual coal/oil firing and this project is scheduled for completion in May 1983.

30479 (EPRI-WS—80-141, pp 4.1-4.29) **Oil to coal conversion options.** Philipp, J. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

Pending legislation on oil backout includes a requirement for a significant reduction in utility oil use by 1990. In general, the policies to encourage the use of coal, an abundant domestic energy source, are consistent with the overall national objective of conserving oil and natural gas resources and restricting their use to situations where substitutions are impractical. Increased use of coal by electric utilities may be achieved by adding new coalfired steam generating capacity or by converting existing oil-fueled units to coal. The objective of this presentation is to explore options which may be considered for converting an electric generating unit designed for oil to coal. Both commercially available and near-term technologies are described, their economics compared, and advantages, as well as disadvantages, identified. The options discussed include the addition of new pulverized coal or FBC boilers and conversion to dual coal-oil firing, coal-oil-mixtures, coal-water-mixtures, low or medium Btu gas. Estimated dates of commercial availability of each option are given.

30480 (EPRI-WS—80-141, pp 5.1-5.18) **Flyash erosion of boiler convection banks.** Wright, I.G.; Stringer, J. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

The factors which give rise to erosion and/or corrosion in steam boilers are reviewed with specific reference to inherent differences between boilers designed to burn coal or oil. The regions where erosion has most frequently caused problems in coal-fired boilers appear to be the primary superheater, the reheater inlet, the economizer, and water-wall rear screen tubes. Consideration of reported experience of erosion problems and of currently available analytical information suggests that the major means of reducing or avoiding erosion damage is by careful control of the flue-gas velocity. Channels of high-velocity gas flow should be stopped or dispersed by using baffles, while some areas of localized attack can be protected by shields, overlay coatings, or refractory encasement in severe cases. Soot blowing can be used to minimize the lockage of some flow passages by ash accumulation, but careful control is needed to avoid erosion by the soot blower itself. The use of more finely ground coal may reduce the flyash erosiveness to some extent. The erosivity of coal flyash appears to be a function of the ash content of the coal, and the silica content of the ash, but as yet there is no good parameter to express the erosivity, nor any simple, generally accepted test. Laboratory measurements of relative erosion rates for specific conditions have, however, been used successfully to provide some guidance in the establishment of the relationship between severity of erosion and flue-gas velocity in coal-fired boilers and should be considered. The more compact design of oil-fired boilers requires the acceptance of a reduction in furnace volume when operated on coal or coal-oil mixtures, which may range up to 25 to 37 percent, depending on the coal/oil ratio. Measures which are needed to reduce the likelihood of serious erosion problems center on the reduction of the flue gas velocity.

30481 (EPRI-WS—80-141, pp 6.1-6.10) **Ash chemistry and its effect in boiler furnaces.** Reid, W.T. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

Ash makes up a major difference between liquid and solid fuels, both in quantity and in chemistry. Coal, with 100 to 300 times as much noncombustible inorganic matter as residual fuel oil, and with a chemistry based on silicates rather than vanadates, poses wholly new problems when coal replaces fuel oil in large boiler furnaces. Chief among these is the great decrease in heat transfer with coal because of the rapid slagging and fouling of heat-receiving surfaces. Although these problems with coal have been faced for more than half a century, there is still no universally accepted method based on first principles of predicting ash behavior in pulverized-coal-fired boiler furnaces. The method described here calculates the flow characteristics of a coal ash from its chemical composition, and then relates the calculated fluidity of the hot ash to the heat-release rate in the furnace. Finally, in conclusion, it is strongly recommended that utilities switching from oil to coal recognize the necessity of analyzing the ash of the coal they are burning. In no other way can they be certain that slagging and fouling problems - and ESP performance - can be explained, and, if necessary, be corrected. Matching ash behavior with furnace performance is still more an engineering art than a science, and only as data are accumulated on coal-ash composition and the bahavior of that ash in furnaces will the ability be developed to control slag formation on wall tubes, minimize fouling of convection passes, and insure high collectability of flyash. The key to all these problems is the chemical composition of the ash in the coal.

30482 (EPRI-WS—80-141, pp 7.1-7.18) **Effects of coal use in oil-design furnace.** Llinares, V.; Smith, B.H. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

This presentation discusses the viability of coal as a conversion fuel for units designed for oil firing. Because of the wide variability of coal and its properties, especially the quality and quantity of its ash content, its effects on steam generator capacity and performance can be significant. The material presented highlights the differences between various ranks of coal and their influences on steam generator furnace and convection section design. In conclusion, it is generally not feasible to consider firing straight coal in an oil-designed unit, due to the resultant unit downrating and high conversion costs and downtime. The use of COM will reduce conversion costs significantly, but a downrating will generally be necessary. We must keep in mind that our primary concern is the ash in the coal and its ash constituents which affect fouling and plugging. Each unit will have to be looked at independently to determine the expected capacity based on a specific coal source.

30483 (EPRI-WS—80-141, pp 8.1-8.12) **Environmental control requirements for ion of oil-fired boilers to coal.** McKinney, B.G.; Preston, G.T. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

Environmental controls required for liquid and solid waste effluents from oil-fired boilers converting to coal are not sufficiently defined so that cost estimates can be made with confidence. EPRI projections indicate that if ash and sludge from these plants are ultimately declared hazardous wastes, then the disposal costs would increase by a factor of 10 to 20 from present levels associated with coal-fired plants. Additional research, development and demonstration of processes and methods to meet environmental requirements for liquid and solid waste effluents from plants must be conducted before costs can be estimated reliably. The environmental controls on air emissions from plants converting from oil to coal are moderately well defined in some cases, and preliminary cost estimates can be made. It is clear that the control of particulate, sulfur dioxide and nitrogen emissions could increase operating costs substantially, especially in situations where NSPS or stricter standards are in effect. Cost estimates for controlling the most likely emissions of a plant converted from oil to a coal-based fuel, based on federal regulations in effect now, are shown in Table I. Since environmental regulations have not been established for converting from using oil to a coal-based fuel, each site will have its own set of requirements. Generalized costs for environmental controls required for converted units or plants are uncertain due to the unknown future of regulations and the sensitivity of costs to site-specific conditions.

30484 (EPRI-WS—80-141, pp 9.1-9.6) **Oil replacement options being considered by FP & L.** Cook, M.C.; Furman, R.C. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

The oil dependency of Florida Power & Light Company's generation system is a major concern because of the financial vulnerability that our company has, due to increased oil prices and the

probability of an oil cutoff. For the near term, obtaining more gas, increasing nuclear plant output, and energy conservation are all being actively pursued. Over the long term, FPL needs to find ways to burn coal in our oil plants. The FPL Coal Utilization Project Team has been set up to assess current and future technologies that may lead to the use of coal as a fuel source for FPL at the earliest possible date. The FPL Coal Utilization Project Team has determined that three technologies have the potential for early application to convert existing FPL oil plants to coal. Cleaned coal, coal-oil mixtures (COM) and coal-water slurries (CWS). The initial results indicate that the future technologies of coal liquefaction and coal gasification would be more costly for existing FPL plants than cleaned coal or COM. The preliminary feasibility studies indicated that clean coal conversion may be more cost effective than conversion to COM. Conversion of a plant to COM may only displace a maximum of 40% of the oil used in that plant, whereas a conversion to coal may displace almost 100%. Although clean coal conversion and coal-water slurry conversion are promising, there is also a certain amount of uncertainty and risk involved with either. This is due to the preliminary nature of the engineering and cost estimates and the assumptions concerning coal quality, boiler modifications, and environmental requirements. The conclusions from FPL's preliminary feasibility studies, indicate that more detailed engineering, demonstration, and regulatory investigation is needed for both cleaned coal and coal-water slurries.

30485 (EPRI-WS—80-141, pp 10.1-10.16) **Review of Salem harbor coal-oil mixture project.** Dunn, R.M. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

The objectives of the project were to demonstrate the feasibility of on-site preparation, storage and combustion of a 30% coal and 70% residual oil mixture in an 80 MW Babcock & Wilcox coal-fired boiler which had been converted to oil firing. COM was produced initially from Pittsburgh Seam # 8 coal which had been pulverized in a conventional ball mill which grinds to a nominal fineness of 80% through 200 mesh. The coal was blended with oil utilizing a bladed turbine agitator supported from the top of a cylindrical blending tank. COM blending and stability studies conducted by the University of Massachusetts under EPRI RP1030-3 were used to identify an acceptable surfactant to stabilize the COM to retard settlement of coal particles in storage and transport. The original coal burners were replaced with low pressure (40 psi) air atomized burners expected to minimize tip erosion and plugging. An existing residual oil storage tank equipped with a bladed agitator to further retard coal settling. Initial oil and COM firing with the new burners resulted in unacceptable combustion conditions which required further modifications to burner throats and other adjustments. Both oil and COM firing resulted in high levels of unburned carbon which has been attributed to high levels of asphaltene in fuel oil. Blending and firing of 30% COM was successful, but compliance with particulate emission levels was not achieved. Coal concentration was reduced to 20% while improvements to existing precipitators were evaluated. No significant erosion of equipment handling COM has been noted. Settling of coal particles in storage and in piping has not been detected.

30486 (EPRI-WS—80-141, pp 11.1-11.14) **Use of coal in oil-design boilers.** Manfred, R. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

A near-term option for conversion of oil-design utility boilers and a few coal-design units from oil-firing to coal-firing is promised by the use of highly concentrated slurries of finely ground coal in water. The coal-water slurries (CWS) would be useable without major modifications to the fuel transportation, storage and handling facilities. The technology for preparing pumpable, stable slurries containing 70% to 75% coal in 25% to 30% water is under development at a number of facilities. The slurries also typically contain 1.0% stabilizing additives. Various coal feedstock, coal treatment processes, grinding methods and stabilizing processes are used by different firms. Ton quantities of such slurries have been prepared and limited combustion tests in 1 MM Btu/hr, 4 MM Btu/hr and 3.5 MW burners have been reported. Development projects are underway to fully develop and scale up slurry preparation processes, and to demonstrate stable combustion in boilers. Projects are being planned to identify modification requirements (e.g. burners, pumps, instrumentation, emission control), to assess benefits and, finally, to demonstrate CWS performance in a full-scale utility boiler.

30487 (EPRI-WS—80-141, pp 12.1-12.14) **Economic replacement of oil and gas with coal in the electric utility sector.** Stauffer, C.H. Jr. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

The paper discusses a) past, present, and proposed government attempts to reduce the use of oil and/or gas in utility boilers; b) the economics of oil and gas replacement with emphasis on reconversions and accelerated replacement; c) real world constraints to such replacement; and d) forecasts of the potential oil/gas savings by regions and related effects, including costs and air pollutant emissions.

30488 (EPRI-WS—80-141, pp 15.1-15.11) **FP & L's Sanford coal-oil mixture demonstration project.** Slepow, L.D.; Mendelssohn, A.S. Jul 1981. NTIS, PC A11/MF A01.

In Seminar proceedings: the use of coal in oil-design utility boilers.

Florida Power & Light Company has conducted a comprehensive test of coal-oil mixture, or COM, as an alternate boiler fuel in Sanford Unit No. 4, a 400 megawatt unit, to determine the problems associated with burning coal in a boiler originally designed to burn oil. FPL has undergone this test because of its desire to reduce its dependence on oil. Within its generation system there are nine 400 MW units and four 800 MW units, all designed to burn oil, and all are candidates for an alternate fuel. This presentation gives a detailed look at the preparation plant built to make COM for the demonstration and the modifications that FPL made to the Sanford Plant in order to allow it to burn COM. The problems that developed during the lessons learned in the handling and burning of COM are discussed. A summary of the results generated in burning COM with up to a 50% coal concentration is also be presented. Coal-oil mixture appears to work as a substitute for oil in Florida Power & Light Company's 400 MW units. But a 50% COM only displaces about 40% of the oil used. The high capital and operating cost of COM preparation facilities, plant modifications and emission control equipment offsets much of the economic advantage of coal vs. oil. Since the coal concentration in COM is limited to only 50% because of viscosity problems, it would be preferable to burn coal without mixing it with oil. Based upon the Sanford Plant's performance on COM, it would appear that, at some units, it may be possible to burn some form of coal directly or in a water slurry, thus displacing a greater quantity of oil. FPL is currently looking at these alternatives and plans to pursue them to determine their technical and economic viability.

30489 **Fluidized-bed combustion: an emerging technology.** Friedrich, F.D. Ottawa, Ontario; CANMET-Energy Mines and Resources Canada (1980). 17p. (CANMET—79-39).

New combustion technology is required to meet the twofold challenge of utilizing increasingly low-grade fuels and simultaneously reducing emissions harmful to the environment. In this respect, the paper identifies fluidized-bed combustion as one of the most promising new technologies, which furthermore has reached commercial demonstration in small sizes. The fluidized combustion process is described together with its advantages, disadvantages, and potential applications. The current state-of-the-art is summarized. Also, the objectives and status of the federal fluidized-combustion demonstration program is reviewed.

30490 **(IRT—19600/1) Materials-process-product analysis of coal process technology. Phase III, Task 1 report, direct combustion, and sulfur emissions control and recovery processes. Volume 1. Results.** (International Research and Technology Corp., McLean, VA (USA)). 16 Aug 1979. Contract AC01-78ET12300. 46p. NTIS, PC A03/MF A01. Order Number DE81028858.

A Materials-Process-Product Model of coal process technology has been developed for the US Department of Energy. This model is an application of a methodology, previously developed

under a grant from the National Science Foundation, for systematically analyzing an array of competing manufacturing technologies from economic, environmental, and energy policy perspectives. The model consists of a data base for coal-related materials and coal conversion processes and an algorithmic structure that facilitates systematic evaluations in response to estogenously specified variables such as tax policy, environmental limitations, and changes in process technology and costs. The model has been developed as an interactive program, with maximum flexibility for inclusion of new process data, revision of old data, and specification of exogenous data related to policy options. It is operational on the Energy Information Agency computer installed at Rockville, Maryland, an IBM-370 series machine. This report includes material on expansion of the MPPM Data Base in the area of direct combustion, and sulfur emissions control and recovery processes. This volume I, summarizes the work done and presents results of some analyses that was accomplished using the new data base elements.

30491 **(MCR—76-323) Development of ammoniated salts thermochemical energy storage systems. Phase I, Task 1: evaluation of design and uses. Topical report.** (Martin Marietta Corp., Denver, CO (USA)). 25 Jun 1976. Contract AC03-76SF90359. 20p. NTIS, PC A02/MF A01.

This program is developing an energy storage system that accepts thermal energy at high temperature, stores it at near ambient temperature, and recovers the energy on demand at a temperature near the original high temperature. The energy is stored as both sensible heat and chemical energy. The system is completely passive, having no moving parts, and can be used over a wide range of source temperatures. The concept consists of the storage and subsequent abstraction of heats of reaction from a pair of ammoniated chemical systems near equilibrium. By shifting the equilibrium in the forward or reverse direction, the heat of reaction is stored and recovered as desired. This energy storage system could be used to provide peaking energy to a peaking turbine, for residential energy storage and to store and recover waste heat from an industrial complex. The end objective of the work was to demonstrate the concept's applicability to power plant thermal storage systems. The objectives of Phase I, Task 1 were to explore system concepts involving ammoniated salts, select 8 ammoniated salt reactions to be evaluated and to evaluate the concepts technically and economically. The task has been completed and is reported herein.

30492 **(MCR—76-502) Development of ammoniated salts thermochemical energy storage systems. Phase I, Task 3: salt kinetics. Topical report.** (Martin Marietta Corp., Denver, CO (USA)). 17 Sep 1976. Contract AC03-76SF90359. 39p. NTIS, PC A03/MF A01. Order Number DE81026465.

This program is for the development of an energy storage system that accepts thermal energy at high temperatures, stores it at near ambient temperature, and recovers the energy on demand at a temperature near the original high temperature. The energy is stored as both sensible heat and chemical energy. The system is completely passive, having no moving parts, and can be used over a wide range of source temperatures. The concept consists of the storage and subsequent abstraction of heats of reaction from a pair of ammoniated chemical systems near equilibrium. By shifting the equilibrium in the forward or reverse direction, the heat of reaction in stored and recovered as desired. This energy storage system could have a role in providing peaking energy to a peaking turbine, for residential energy storage, and to store and recover waste heat from an industrial complex. The end objective of the work is to demonstrate the concept's applicability to power plant thermal storage systems. To this end a three-phase program is planned. The objectives of Phase I, Task III were to determine the kinetics of the dissociation and recombination of 10 candidate ammoniated salts, (calcium, ferrous, and magnesium salts) and to determine the effects of cycling, impurities, moisture and particle size on the kinetics. Heats of reaction for each of the salts were measured. All of the calcium chloride ammoniates reacted both reversibly and reproducibly. A large volume expansion accompanied the formation of all of the salts when ammoniates were formed from the anhydrous salts. This large volume change eliminated any effects of original particle size (100 to 400 mesh). Reproducible rates of reaction could not be obtained with $FeCl_2$ salt from 3 different sources, nor with the Mg Cl_2 salts obtained from two different sources. Anhydrous magnesium chloride prepared in the laboratory gave completely reversible, reproducible results in much the same manner as the calcium salts. (LCL)

30493 **(MCR—76-562) Development of ammoniated salts thermochemical energy-storage systems. Phase I initial assessments. Progress report, March-September 1976. Final report.** (Martin Marietta Corp., Denver, CO (USA)). 24 Sep 1976. Contract AC03-76SF90359. 94p. NTIS, PC A05/MF A01.

This program is developing an energy storage system that accepts thermal energy at high temperatures, stores it at near ambient temperature, and recovers the energy on demand at a temperature near the original high temperature. The energy is stored as both sensible heat and chemical energy. The system is completely passive, having no moving parts, and can be used over a wide range of source temperatures. The concept consists of the storage and subsequent abstraction of heats of reaction from a pair of ammoniated chemical systems near equilibrium. By shifting the equilibrium in the forward or reverse direction, the heat of reaction is stored and recovered as desired. This energy storage system could have a role in providing peaking energy to a peaking turbine, for residential energy storage and to store and recover waste heat from an industrial complex. The end objective of the work was to demonstrate the concept's applicability to power plant thermal storage systems. Chemical kinetics data were obtained for candidate salts. A bench scale model was designed, built and tested to obtain engineering data required for design of a larger system. A 4 MW-hr subscale research experiment was planned. The results for each phase of the program are presented. It was concluded that ammoniated salt energy storage systems would be usable in electrical steam power systems for feedwater preheat and for latent heat storage. An upper temperature limitation of 700°F for the selected ammoniated salts would preclude their use above that temperature. However, there are other salts, which have not yet been investigated, which may prove suitable for use at higher temperatures. (LCL)

30494 **(ORNL—5739) PICES: a computer code for evaluation of electric utility static generation reliability.** Greene, S.R. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 94p. NTIS, PC A05/MF A01. Order Number DE81029097.

The most commonly used static generation reliability index in the United States is the system loss-of-load expectation (LOLE). While the LOLE is a well-defined mathematical concept, the index lacks significance for many utility consumers - a fact of increasing importance in a time when utilities are being called on to justify construction of each new plant. Recently, attempts have been made to develop and implement the use of planning criteria that are both mathematically exact and meaningful to the utility consumer. Indices that measure expected frequency and duration of capacity deficiency have emerged as indicators to meet this need. A computer code called PICES (Probabilistic Investigation of Capacity and Energy Shortages) has been developed for estimation of a utility's expected frequency and duration of capacity deficiencies on a daily on- and off-peak basis. In addition to the aforementioned indices, this code calculates the system loss-of-load probability (LOLP), LOLE, and the probability and expected frequency and duration of a range of system reserve margins on a daily on- and off-peak basis. All results are aggregated and expressed as weekly, seasonal, or annual values. When combined with the appropriate system emergency operating procedure (EOP) information, the code is a useful tool for evaluating the need for additional generating and intertie capacity as well as the effectiveness of various system EOPs. The methodology of the code is described, and use of the code is demonstrated with an example problem. Application of the code to utility-planning problem areas such as EOP effectiveness and wind and solar technology value assessment is discussed.

30495 **(PB—81-117939) Treated water demand and the economics of regionalization. Volume 2. Economics of regionalization: the electric power example. Final report, April 1978-December 1979.** Hooks, D.L. (Alabama Univ., University (USA)). Aug 1980. 62p. NTIS, PC A04/MF A01.

This two volume report examines the present and future demands and costs for residential water in view of the new require-

ments for water quality standards under the Safe Drinking Water Act of 1974. This volume investigates consolidation in the electric power supply industry as an example of a possible method of offsetting the increased costs of water treatment that will be incurred under the new Federal regulations. The structure of the power industry is examined and the history advantages, and cost benefits of coordination are evaluated. Several alternatives to the present system are considered, including consolidation of existing systems, encouragement of competitive markets, and public ownership of generation and transmission facilities.

30496 **(TVA/OP/EDT—81/26) Examining relationships between coal characteristics and the performance of TVA power plants. Interim report, November 1980.** Barrett, R.E.; Gregory, A.M.; Holt, E.C. Jr. (Battelle Columbus Labs., OH (USA); Hoffman-Muntner Corp., Silver Spring, MD (USA)). 1980. 129p. NTIS, PC A07/MF A01.

In March 1979, Battelle began a study for TVA to examine relationships between coal characteristics and the performance of TVA power plants. The following measures of power plant performance were deemed to be of interest: boiler capacity, boiler availability, efficiency, operating costs and maintenance costs. The initial effort emphasized the acquisition of data on the physical and chemical properties of coal used at all TVA plants in 1977, and on plant design and performance. Some of the plant performance parameters that have been the subject of analysis to date include heat rate, boiler efficiency, unit capacity, boiler availability, slagging outages, and maintenace costs. A few initial results for each of these areas are summarized. (LCL)

30497 **Goeteborg warms to waste-heat tunnel.** *Electrical Review International ;* **298**: No. 5, 70(6 Feb 1981).

A 3.4 km long tunnel under the River Goeta, which carries waste heat from the Shell refinery on Hising Island, Sweden to the center of Goeteborg's district heating system is discussed. The tunnel, which reaches a depth of 140 meters and is the longest of its kind in Europe, transports 2,400 cubic meters/hour of water at temperatures from 65 to 100 degrees C. It is estimated that it will save the community of Goeteborg SwKr50m/year in oil bills. (JMT)

30498 **Carry-over grain stocks as an emergency fuel.** Davitian, H.; Serry, H. (Brookhaven Natl Lab, Upton, NY). *Energy (Oxford) ;* **5**: No. 12, 1223-1229(Dec 1980).

In a typical year, the U.S. has carryover stocks of grain with a total energy content of 0.5-1.0 quad (10/sup 15/ Btu). These stocks could serve as an emergency supply of solid fuel which could provide a partial substitute for coal in coal power plants. Although the stocks would be a costly substitute for coal, they would be cheaper than some alternative power sources. 8 refs.

30499 **Condensation on immiscible falling films.** Jacobs, H.R. (Univ of Utah, Salt Lake City). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-110, 1-7(Jul 1980).

This paper presents an analytical study of the process of direct contact condensation of a saturated vapor on an immiscible laminar falling liquid film flowing over a nonconducting plate. The solution is applicable to those immiscible fluid combinations where the surface tension allows the condensate to form a continuous layer wetting the falling film. The local Nusselt number and integrated average Nusselt number are presented as a function of the Jakob number, falling film Reynolds number, and the ratios of the two liquids' thermal conductivities, viscosities and Prandtl numbers. 12 refs.

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REFER ALSO TO CITATION(S) 29890, 29892, 29897, 29916, 29917, 30472, 30489, 30490, 30542, 31120, 31191, 31302

30500 **(ANL/CEN/FE—80-22) Sampling and analysis of hydrocarbons in combustion gases. Quarterly report, October-December 1980.** Johnson, I.; Myles, K.M.; Siczek, A.A.; Fee, D.C. (Argonne National Lab., IL (USA)). Jun 1981. Contract W-31-109-ENG-38. 25p. NTIS, PC A02/MF A01. Order Number DE81028478.

The purpose of these studies is to develop a methodology for the chemical analysis of ultratrace levels of polycyclic organic compounds in the flue gases from fluidized-bed combustors. Extant methodology in the literature for the chemical analysis of polycyclic aromatic hydrocarbons (PAHs) present in stack emissions at ultratrace levels is described and critically evaluated. In the measurement of organic matter at such trace levels, the three distinct areas of importance are sample collection, sample recovery, and sample analysis. Currently, the degree of confidence differs for each stage; there is more confidence in analysis by GC/MS (gas chromatography/mass spectroscopy) than in the other areas. Present methods of sample collection from the stack involve filters and polymer sorbents. The sampling system generally shows good efficiency, but has not been extensively tested under field conditions. The recommendations for further developments and improvements in sample collection strategy are discussed.

30501 **(DOE/ET/12442—T2) Design and test of an exhaust gas clean-up system for power plants using high sulphur content fuels. Final report.** Chang, C.N. (International Power Technology, Inc., Sunnyvale, CA (USA)). 10 Oct 1980. Contract AC03-78ET12442. 140p. NTIS, PC A07/MF A01. Order Number DE81026513.

This experimental program, initially designated to study an exhaust gas cleanup and water recovery system for a Cheng Cycle Dual-Fluid (CCDF) turbine power plant using sulfur rich fuels, has shown the potential of a general Flue Gas Desulfurization (FGD) system applicable to utility and industrial boilers as well. The process was studied both theoretically and experimentaly. Experiments were performed using a bench scale (25k equivalent) apparatus and a pilot scale (1Mw equivalent) apparatus. Data obtained indicated the IPT process potentially can out-perform the conventional FGD process with significant cost savings.

30502 (DOE/MC/08333—167, pp 1-16) **Overview of the Department of Energy's Pressurized Fluidized-Bed Combustor Cleanup Technology Program.** Moore, W.E. (Dept. of Energy, Washington, DC). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The Department of Energy's (DOE) Fossil Energy, Office of Coal Utilization's Pressurized Fluidized-Bed (PFBC) Cleanup Technology Program is reviewed. The PFBC cleanup program has two goals: removing contaminants from the gas stream to meet turbine tolerance for erosion/corrosion and deposition; and removing pollutants from the gas stream to meet the New Source Performance Standards (NSPS). The program involves three development areas: particulate control, alkali control, and particulate-alkali measurement. The overall program schedule is presented along with a summary status. Finally, the key technical issues are outlined which must be solved for the cleanup equipment to meet contaminant removal goals. To achieve overall program goals will require the coordinated effort of both the public and private sector. This paper seeks to promote this coordination by presenting DOE's PFBC cleanup program, and it is hoped that this program description will improve communication and the end result will be a well coordinated program leading to development of an acceptable cleanup train for ensuring early commercialization of PFBC combined cycle power systems.

30503 (DOE/MC/08333—167, pp 17-20) **Prospects for the pressurized fluidized bed combuster in the electric power utility industry.** Tassicker, O.J. (Electric Power Research Inst., Palo Alto, CA). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The pressurized fluidized bed combustor with combined steam and pressurized gas cycles, holds prospects for the electric power utility industry. There are many attractive features in this technology which are detailed in this paper.

30504 (DOE/MC/08333—167, pp 27-36) **Curtiss-Wright Pilot Program.** McClung, J.D. (Dept. of Energy, Morgantown, WV). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The US Department of Energy initiated a program in 1976 with the Curtiss-Wright Corporation to design, construct and operate a high-sulfur coal-fired, combined-cycle pilot plant using the PFBC concept. In addition to the pilot plant, the program involves conceptual commercial design and supporting experimental work. A brief overview of the program, its goals, significant accomplishments to date, and present status are presented.

30505 (DOE/MC/08333—167, pp 37-62) **1000 hour PFBC test at CURL.** Roberts, A.G. (National Coal Board's Coal Utilisation Research Labs., Leatherhead, England). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The performances of gas cleaning cyclones used in a recent 1000 hour program on the Leatherhead PFBC facility are described. Extrapolation to commercial plant suggests that gas turbines can probably be protected from erosion by the use of cyclones but that NSPS emissions standards will require some additional clean-up device. Engineering experience with the cyclones and associated dust removal equipment is summarized.

30506 (DOE/MC/08333—167, pp 63-82) **Particulate control during 1000-hour test of gas turbine operated on PFBC gas stream.** Cole, R.W. (Curtiss-Wright Corp., Wood-Ridge, NJ). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

For a six-month period in 1979 the PFB/SGT Technology Rig at Curtiss-Wright was operated for a total of 1700 coal-burning during which two tests of the small gas turbine were conducted. The first test was aborted at 150 h because of poor functioning of two cyclones in the cleanup train which resulted in carryover considered excessive. After cyclone design changes were made, the second test accomplished 1000 h of turbine operation at temperatures above 1500°F with the PFBC operating at 1650°F. Erosion of the turbine blading was minimal and not sufficient to cause measurable performance degradation. Configuration and design performance of the three-cyclone cleanup train are described and actual performance on overall and grade efficiency basis of the cylones is discussed. Resulting particle size and loading are compared to anticipated turbine life requirements.

30507 (DOE/MC/08333—167, pp 83-96) **Hot-gas cleaning with ceramic filters.** Shackleton, M.; Chang, R.; Sawyer, J.; Kuby, B. (Acurex Corp., Mountain View, CA). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

A barrier filter system employing ceramic fibers in the filter media is being developed which will extend the range of application of particulate control in gas filtration to temperatures of 800°C. This development is aimed at advanced coal utilization processes but, because of the chemical inertness of the ceramic media, it will be useful in a wide range of applications. Progress to date in the development of this new filtration device is reviewed.

30508 (DOE/MC/08333—167, pp 97-110) **Hot-gas clean-up using ceramic cross-flow membrane filters.** Ciliberti, D.F.; Ranadive, A.Y.; Alvin, M.A.; Keairns, D.L. (Westinghouse R and D Center, Pittsburgh, PA). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

This program has been directed at the development of ceramic cross flow filters that offer very high filter area to filter volume ratios. This paper presents a description of the filter module concept, a brief review of small filter element performance at high temperature, a description of the filter system being pursued in the current work and finally a report that the status of the current program is such that the fabrication of a new high temperature and pressure test facility is virtually complete and the experimental tasks of the current program are about to begin.

30509 (DOE/MC/08333—167, pp 111-134) **Cyclocentrifuge for hot-gas-particulate removal.** Brown, A.T. (Mechanical Tech. Inc., Latham, NY). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The status of the program to develop the cyclocentrifuge, a device for the removal of particulates from hot gas streams, is reviewed. Results of the tests conducted at room temperature using methylene blue and also flyash are presented. The design of a cyclocentrifuge to be tested in the 1000°F gas stream of the METC gasifier during CY81 is described along with the particulate measurement scheme which uses laser Spectrometers. The gas cleanliness attainable using the cyclocentrifuge in coal gasification and PFB processes is predicted.

30510 (DOE/MC/08333—167, pp 135-146) **Electrocyclone for high temperature/pressure dust removal.** Boericke, R.R.; Giles, W.G.; Dietz, P.W.; Kalio, G.; Kuo, J.J. (General Electric Co., Schenectady, NY). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

In response to the need for a high efficiency, high throughput gas cleanup device, General Elctric has experimented with an electrostatically augmented cyclone. In this paper, the Electrocyclone concept, its advantages, and its theory of operation are discussed. Recent experimental results with an 18-inch cold flow laboratory model are reviewed and compared with an analytical model developed at General Electric. Comparisons of the measured and predicted fractional efficiency show good agreement over a range of flowrates and electrode voltages. Using the same computer model, the projected performance of prototype equipment for a 660 MWe PFBC power plant is examined, and plans for the continued development of the Electrocyclone are summarized.

30511 (DOE/MC/08333—167, pp 147-154) **Centrifuge wedge separator.** Linhardt, H.D. (Linhardt and Associates, Inc., Newport Beach, CA). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The project entitled investigation of high velocity wedge separator for particle removal in coal gasification plants has completed phase I, related to theoretical investigations (Ref.1) and phase II, consisting of experimental investigations (Ref.2). During phase II the HTPS-I was tested for short duration at 1800°F and 450 psia. The results are briefly discussed and future work indicated (phase III).

30512 (DOE/MC/08333—167, pp 155-162) **High-temperature high-pressure electrostatic precipitator.** Kumar, K.S. (Cottrell Environmental Sciences, Somerville, NJ). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

This paper presents the existing status of the DOE contract that was received in October 1980 for the testing and evaluation of electrostatic precipitator (ESP) for hot gas cleanup following the PFBC effluents. An overview of the program is given here, with special emphasis on the ESP component design philosophy.

30513 (DOE/MC/08333—167, pp 163-184) **DRI high-temperature/high-pressure electrostatic precipitator test facility.** Rinard, G.; Durham, M.; Armstrong, J.; Gyepes, R. (Univ. of Denver, CO). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

Electrostatic precipitators (ESP) have the potential of being one of the few hot gas cleanup devices capable of meeting EPA New Source Performance Standards, and are being considered for use with pressurized fluidized bed combustors. Previous experimental work with ESP's at high temperature/high pressure conditions is reviewed, and the design, installation and operation of a pilot-scale test facility for testing ESP applications to hot gas particulate cleanup is described in detail. (LCL)

30514 (DOE/MC/08333—167, pp 219-233) **Acoustic agglomeration of power plant fly ash.** Reethof, G. (Pennsylvania State Univ., University Park). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

Results are reported of a research project investigating the agglomeration of submicron fly ash particles as a function of sound pressure level (100 to 140 dB), sound frequency (1000, 2000, 3000, and 4000 Hz), loading (1 gram/m^3 to 4 grams/m^3) and exposure times (up to 40 seconds). A new 600 W siren operating at these frequencies and providing the required acoustic levels has been designed and successfully tested. The reverberant acoustic field in the P.S.U. chamber was studied and shows the expected large level variations of up to 30dB. The spatial variation of the acoustic field hs been included in our computerized analytical model of the agglomeration process. Good progress has been made toward demonstrating that parametric acoustic effects show promise of an effective sonic-ultrasonic agglomeration approach. The preliminary design of a medium temperature (700°F) acoustic agglomeration test facility has been completed. A comprehensive 2 year research proposal has been submitted to DOE-METC to continue the research and development.

30515 (DOE/MC/08333—167, pp 363-384) **Combustion stream modeling for combined cycle processes: implications with respect to alkali-induced corrosion.** Gruninger, J.H.; Yousefian, V.; Duff, J.W.; Stewart, G.W. (Aerodyne Research, Inc., Bedford, MA). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

A multicomponent ideal solution model has been developed to predict the concentration of alkali aluminosilicates and other condensed species in combustion streams. To date, most chemical equilibrium codes consider only pure condensed species. This is a serious restriction for modeling coal combustion streams since liquid species, which in their pure form are only stable above their melting point, can form as a liquid solution at lower temperatures. Using this ideal solution model, we have predicted the combustion stream composition for an advanced combined cycle configuration utilizing a pressurized fluidized bed combustor and a direct fired gas turbine. From these calculations, it is shown that the alkali content in the combustion stream exists primarily as condensed alkali-aluminosilicates. The fusion temperature of the aluminosilicates vary from 800 to 1000°K depending upon the composition of the feed stock. Details of the modeling as well as implications with respect to alkali-induced corrosion of turbine blades is discussed.

30516 (DOE/MC/08333—167, pp 385-404) **Removal of alkali vapors by a fixed granular-bed filter using activated bauxite as a filter medium.** Lee, S.H.D.; Johnson, I. (Argonne National Lab., IL). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

A fixed granular-bed filter is being evaluated for the removal of gaseous alkali metal compound from the flue gas of a pressurized fluidized-bed coal combustor (PFBC). Activated bauxite was found to be a very effective sorbent and to be a suitable filter medium in a granular-bed filter. Experimental results are presented of: (1) tests of sodium chloride vapor sorption by activated bauxite, using simulated flue gas of a PFBC; and (2) water-leaching regeneration of activated bauxite. A preliminary economic evaluation is given, along with the energy requirement for operating a fixed granular-bed filter containing activated bauxite as a filter medium.

30517 (DOE/MC/08333—167, pp 405-420) **A.P.T. Dry Plate Scrubber for alkali vapor control.** Calvert, S.; Amladi, P.; Yung, S. 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The A.P.T. Dry Plate Scrubber (DPS) uses one or more shallow, dense mobile beds of solid granules supported on perforated plates to remove impurities from a gas stream. It is especially well suited for the simultaneous removal of alkali vapors and particles from high temperature and pressure gases such as those emitted from pressurized fluidized bed combustion processes. Preliminary experiments are being conducted to establish design criteria for alkali removal in a high temperature and pressure bench scale DPS. Sorbent evvaluation experiments have been run to identify potentially useful sorbent materials. Among the 13 sorbents tested at 790°C and 1 atm, diatomaceous earth, activated bauxite and dolomite were found to be the most promising for sodium capture. Sorption capacity experiments are now in progress in order to obtain the sorption capacity of diatomaceous earth. A laboratory scale, single stage DPS has been designed and fabricated for studying the mass transfer rate, the attrition behavior and alkali penetration at 800°C and 1 atm. A preliminary process design for the bench scale evaluation of the DPS at 900°C and 10 atm is also presented.

30518 (DOE/MC/08333—167, pp 421-442) **Alkali control in fluid bed combustion systems at CPC.** Cooper, J.L.; Moresco, L.L. (Combustion Power Co., Inc., Menlo Park, CA). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

From a series of wood- and coal-fired combustion tests conducted on subpilot fluid bed combustion systems at Combustion Power Company prior to 1979, it was concluded that selected aluminosilicate sorbents can be added with the fuel in the combustor to reduce alloy corrosion rates and alter the properties of the combustion particulates and related deposits. While most evidence has been indirect, the aluminosilicate combustion additives suppress reactive alkalis by forming stable, high-melting-point solids of sufficient particle size to be removed from the system by hot cyclones and the high temperature, moving Granular Bed Filter under development. Current program emphasis is on improving analytical techniques for measuring projected low level alkali vapors in the upcoming coal-fired tests, which will utilize aluminosilicate combustion additives to suppress reactive alkali compounds.

30519 (DOE/MC/08333—167, pp 457-470) **Alkali control in PFB combustion systems.** Boericke, R.; Luthra, K.; LeBlanc, O.; Zarchy, A. (General Electric Co., Schenectady, NY). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

General Electric is currently investigating two promising concepts for removal of corrosive alkali vapor from PFB combustion gases: surface ionization/electrostatic collection, and adsorption. In the surface ionization concept, the high temperature combustion gases are passed over a surface having a high work function which selectively ionizes the alkali species. The ionized alkali is then collected electrostatically on a cooled electrode biased with respect to the grounded ionizing surface. The concept has been demonstrated as an alkali measuring device and its application as an alkali scrubber is currently under investigation. The results of preliminary experiments are reviewed and discussed. The GE alkali adsorption work is based on the generation of an adsorbent smoke of sub-micron particles by combustion of liquid chlorides of aluminum, silicon or other metals. Work to date has focused on measurements of alkali adsorption at high temperature using real-time measurement of weight gained by activated bauxite when exposed to varying concentrations to various alkali species. Experimental results for several alkali compounds have been analyzed and are shown to correlate with the B.E.T. adsorption isotherm theory.

30520 (DOE/MC/08333—167, pp 471-490) **Testing and verification of granular bed filters for removal of particulates and alkalies.** Lippert, T.E.; Ciliberti, D.F.; Bachovchin, D.M.; Piermann, R.A.; Zenz, F.A. 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The granular bed filter (GBF) is proposed as a device to clean pressurized fluidized bed combustion (PFBC) gas streams. In this work, the Ducon fixed-bed GBF will be evaluated in a multi-element pilot-scale unit that will be tested at mass flows to 3.2 kg/s (7 lb/s), pressures to 1033 kPa (150 psi) and gas temperatures to 870°C (1600°F) using a dust feed of redispersed PFBC flyash. Discussed is the overall GBF concept, its design and operating basis, and the major and technical uncertainties. Differences in the proposed GBF pilot unit design and test units previously evaluated are highlighted.

30521 (DOE/MC/08333—167, pp 491-506) **Electrostatic granular bed filter development program.** Boericke, R. (General Electric Co., Schenectady, NY); Dietz, P.; Snaddon, R.; Alexander, J.; Presser, A. 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

General Electric Company, working with EFB, Inc., has investigated the application of EFB's unique electrostatic granular bed filter to high temperature, high pressure gas cleanup. Cold flow experiments designed to provide engineering data have been completed, including tests with simulated sticky powder to demonstrate that plugging of the front face can be avoided. A theoretical performance analysis based on the unit cell model, and including electrostatic effects has been developed, and is currently being validated with carefully controlled laboratory experiments. Results from these laboratory programs are reviewed and a conceptual system design for a PFB power plant, based on these results, is presented.

30522 (DOE/MC/08333—167, pp 507-534) **High temperature moving Granular Bed Filter Development Program at Combustion Power Company.** Moresco, L.L.; Cooper, J.L. (Combustion Power Co., Inc., Menlo Park, CA). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The continuous Granular Bed Filter under development has operated over 1000 h at 840°C on a low pressure coal-fired fluid bed system (0.18 m^3/sec, 1600 acfm) removing more than 99% of the combustion particulate. Program results to date and future work presented here are focused on numerical analysis of the filter, improvement of measurement techniques, data analysis, and modifications to the combined coal-fired Fluid Bed Combustor-moving Granular Bed Filterer test facility. Numerical modeling of the filter is oriented towards correlation of ambient and high temperature data from the existing GBF test facility and prediction of pressurized filtration characteristics. Measurement improvements are focused on improving available analytical techniques for particulate loading and size measurements in small high temperature ducts. Test facility modifications to improve the external components of the GBF and to optimize the GBF internals for improved gas distribution and granular collector flow have been determined for experimental investigation. The current program is directed towards high temperature coal combustion gas stream particulate removal for erosion reduction in systems downstream of the moving granular bed filter.

30523 (DOE/MC/08333—167, pp 535-558) **A.P.T. Dry Plate Scrubber for particulate control.** Parker, R.; Jain, R.; Le, T.; Calvert, S. 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The A.P.T. Dry Plate Scrubber (DPS) uses one or more shallow, dense mobile beds of solid collector granules supported on perforated plates to remove impurities from a gas stream. It is especially suited for cleaning high temperature and pressure gases such as the effluent from a pressurized fluidized bed combustion (PFBC) process. The DPS is being further developed and tested under the sponsorship of the US Department of Energy. Experiments have been performed on single and multiple stage DPS units under controlled laboratory conditions. The purpose of these experiments is to determine the effects of collector diameter, density, conductivity, jet diameter, jet plate geometry, bed depth, gas superficial and jet velocities, and collector feed rates. Electrostatic forces have been used to improve the collection efficiency of the DPS. The data will be used to establish design criteria for a high temperature and presssure bench scale unit. Experimental results obtained to date show that a three stage electrostatically augmented DPS can meet the most stringent particle removal goals specified in the DOE PRDA. A preliminary process design for bench scale evaluation of the DPS at high temperature (900°C) and pressure (1000 kPa), is presented.

30524 (DOE/MC/08333—167, pp 559-572) **Summary report on demonstration of the feasibility of a magnetically stabilized bed for the removal of particulate and alkali.** Golan, L.P.; Matulevicius, E.S. (Exxon Research and Engineering Co., Florham Park, NJ). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

Cleanup of the flue gas from a pressurized fluidized bed combustor to a degree which will prevent damage to a gas turbine is a major technical problem. In July 1980 Exxon initiated a DOE sponsored experimental program to investigate a novel technique which promises to effectively meet these hot gas cleanup needs. In this concept flue gas treatment will occur in a cross-flow bed stabilized by a magnetic field. The bed consists of ferromagnetic and non-magnetic materials for particulate and alkali capture. The advantages of this system include: high throughput rates, high particulate capture efficiency, trace metal removal, and applicability to a wide variety of coals. An overview of the program including a discussion of the theoretica/experimental basis of the program and the progress to date is included in this paper.

30525 (DOE/MC/08333—167, pp 573-582) **Electrofluidized-bed filter.** Melcher, J.R.; Presser, A.M. 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

Experiments performed to determine the collection efficiency and operating characteristics of electrofluidized (EFB) and electropacked (EPB) beds tested for the collection of fine particulate combustion products in flue gas from atmospheric pressure fluidized bed combustors are reported. The experimental work reported is limited to temperatures below 1400°F. Electrofluidized and electropacked beds are particle collection devices which offer high collection efficiency in a small volume using materials, e.g., sand or glass beads, that are relatively insensitive to the effects of a harsh environment. Previous studies showed that the EFB and EPB appear to be candidates to solve medium and high temperature collection problems. EFB's offer higher throughput than EPB's but the difficulties raised by the need for an adhesive agent focussed the first part of this work on EPB's, where basic issues of collection and energy usage might be studied more easily. The experimental equipment and methods used for measuring both collection efficiencies and electrical power losses are described. EPB results showed collection efficiencies above 99% for bed temperatures from 300 to 1200°F, but that power losses became comparable to fan power requirements as the temperature was increased above 1100°F. Experimental results on the temperature dependence of effective electric conductivity of several materials as measured in a packed bed are also presented. It was concluded that although electrical losses appear to be an important limitation on the use of imposed fields to improve fine particle collection efficiency in either packed or fluidized beds (or some combination of these), limitations may be compensated by the identification of a bed material that is more resistive at elevated temperatures, or by the realization that the improvement in gas residence time justifies the electrical power requirements. (LCL)

30526 (DOE/MC/08333—167, pp 583-598) **Glass entrainment of fly ash at high temperatures.** McCreight, L.R. (General Electric Co., Philadelphia, PA). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

A novel continuous process somewhat analogous to various wet wall particle collection systems but using molten glass at elevated temperatures is being developed. It is aimed at overcoming problems in some systems of ricochet and particle fracture followed by reentrainment without the need for back flushing or rapping while actually capitalizing on the tendency for fly ash to cake and stick. It utilizes inexpensive glass cullet or incinerator waste container glass in a viscous condition to trap and dissolve the particles. They may be either deflected from the gas stream by aerodynamic action such as due to sudden changes of direction or by actually passing the gases through a shallow layer of molten glass. The final effluent is a low solubility, densified product which can be easily disposed of or possible utilized in some building products. Past

work has demonstrated the feasibility of several aspects of the overall system. Current work is now aimed at more specifically defining and validating the role of the glass. In particular, the program is aimed at defining the efficiency of the glass coated refractories in capturing particulates while hot as compared to results from both cold tests and runs without glass coatings. The latter tests have produced some anomalous results apparently due to electrostatic forces and agglomeration during burner operation, respectively, which are now being clarified.

30527 (DOE/MC/08333—167, pp 599-620) **Development of alkali and trace heavy metal monitors for coal conversion process streams.** Haas, W.J. Jr.; Eckels, D.E.; Kniseley, R.N.; Fassel, V.A. (Iowa State Univ., Ames). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

The instrumentation and procedures developed at the Ames Laboratory for application to the monitoring of alkali and trace heavy metals in coal conversion process streams are described and results that have been obtained are presented. The first Ames instruments, which feature an automated, dual channel flame atomic emission spectrometer, perform the sodium and potassium determinations simultaneously, repetitively, and automatically every two to three minutes by atomizing and exciting a fraction of the subject gas sample stream in either an oxyhydrogen flame or a nitrous oxide-acetylene flame. The analytical results are printed and can be transmitted simultaneously to a process control center. Work on the development of instruments for sequential and simultaneous on-line determination of many other elements that may impact the economics, process chemistry, and/or environmental acceptability of proposed coal conversion/gas cleanup processes are also outlined. The latter instruments are based on inductively coupled plasma excitation of the sample streams.

30528 (DOE/MC/08333—167, pp 621-632) **High-temperature measurements of alkali levels in an experimental 6-inch AFBC.** Grimm, U.; Anderson, R.J.; Romanosky, R.R. (Dept. of Energy, Morgantown, WV). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

Alkali metals (K and Na) were measured with an on-line atomic emission (AE) spectrometer in the effluent stream of a 6-in. dia atmospheric fluidized-bed combustor (AFBC). In an effort to simulate the performance of a pressurized fluidized-bed combustor (PFBC), the AFBC was operated at 1650°F and dolomite was used for the bed material. Pittswick coal was burned during the tests. The on-line AE unit monitored a representative fraction of the effluent stream. The sample stream was provided by a specially designed sample system with the inlet port located in the freeboard of the FBC. The sample system was fabricated of Hastalloy X and could be heated up to 1200°F. In order to control the size of particles in the sample stream, the sample system contained a cyclone designed to have a cut-off diameter of 10 μm. Flow through the sample system was regulated by controlling the pressure of the freeboard from 0 to 20 inches of water. In all tests (even when coal was not being burned in the FBC) a ratio of K to Na of about 3 to 1 was observed. This ratio was verified by analysis of aerosol samples for Test 6 (coal and dolomite feed). However, concentrations of alkali as determined by analysis of aerosol samples for Test 6 were about an order of magnitude higher than those measured by the AE unit. Alkali levels (K and Na) on the order of 10 ppM were measured on the sample stream.

30529 (DOE/MC/08333—167, pp 633-640) **Real time coarse particle mass measurements in a high temperature pressure coal gasifier process treatment.** Wegrzyn, J.; Saunders, J.; Marlow, W. (Brookhaven National Lab., Upton, NY). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

A sampling system has been designed and is under construction at Brookhaven National Laboratory that employs a probe appropriate for direct extracted sampling of erosive range particulate matter from a coal gasifier outlet or a high pressure fluidized bed combustor. The sampling train is scheduled to be tested at the Morgantown Energy Technology Center on their 42 inch coal gasifier unit. This sampling system consists of four modules: (1) a null balance extractive probe with injection through a porous lined tube to minimize wall loss; (2) a stem type virtual impactor to separate coarse from fine particles; (3) a filter tape collector; and (4) a beta gauge total mass detector. The key design feature of this system is a stem type virtual impactor which separates at ambient gas stream conditions the coarse particles from the sampling stream so that at upon filtration no condensible vapors, fine particles or reactive gases pass through the filter tape. This system should provide coarse particle mass flux data with a time resolution of thirty seconds or better. Sampling requirements for high temperature, high pressure aerosols are defined and discussed according to sample integrity, artifacts of measurements, and validity of the signal. For a meaningful, unambiguous measurement, each of the above points must be addressed, and within this framework, this paper describes the direct sampling probe that is being developed at Brookhaven National Laboratory.

30530 (DOE/MC/08333—167, pp 641-652) **Real-time particle mass monitor for pressurized fluidized bed combustion streams.** Wang, J.C.F.; Libkind, M.A.; Hardesty, D.R. (Sandia National Labs., Livermore, CA). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

Mass loading and size distribution of particulate emissions from a pressurized fluidized bed combustor are the critical parameters which the hot gas cleanup components are designed to control. Commercially available instruments for particle detection are either optical devices which do not measure particle mass directly, or sampling devices which do not provide real-time measurements. Recently we demonstrated the feasibility of using the tapered-element oscillating microbalance (TEOM) for real-time particle mass measurements at room temperatures. The objective of the current program, sponsored by Morgantown Energy Technology Center, DOE, is to develop a real-time particle mass monitor for applications in pressurized fluidized bed combustion (PFBC) streams. In the TEOM, a set of new detectors has been developed for high-temperature and high-pressure applications (up to 300°C and 10 atm). Other features of this new particle mass monitor include periodic backflush for long-duration, continuous operations and an interface to a multistaged cyclone train for real-time aerodynamic particle size distribution measurements. The combined system employs modified cyclones from the Acurex Source Assessment Sampling System (SASS) to obtain fractional particulate mass loadings. For the cyclone train, the 50% cut sizes are 1, 3 and 10 μm. In addition, a positive filter collects all particulates less than 1 μm at room temperature and atmospheric pressure.

30531 (DOE/MC/08333—167, pp 653-666) **IPSS-100, a new generation instrument for particle sizing in a combustion stream.** Poon, C.C.; Bachalo, W.D. (Spectron Development Labs., Inc., Costa Mesa, CA). 1981. NTIS, PC A99/MF A01.

From DOE hot gas cleanup contractor's meeting; Morgantown, WV, USA (3 Feb 1981).

A new Integrated Particle Sizing System, the IPSS-100, has been developed. The new instrument will size solid particles in situ in the size range of 0.5 to 30 μm and is particularly useful in satisfying industrial needs for particle measurement downstream of the gas clean-up systems in a pressurized fluidized bed combustor. The IPSS-100 features high-speed data acquisition, simplicity of operation, and accuracy. An optional feature of the IPSS-100 is its capability of sizing droplets between 0.5 and 3000 μm when suitably modified.

30532 (NP—1903744) **316(a) and 316(b) demonstration, Cumberland Steam Plant. Volume 4. Effects of thermal discharges from Cumberland Steam Plant on the fish populations of Barkley Reservoir.** (Tennessee Valley Authority, Norris (USA). Div. of Forestry, Fisheries and Wildlife Development). Mar 1977. 236p. NTIS, PC A11/MF A01. Order Number DE81903744.

The influence of a particular thermal discharge is most likely dependent on the ecological characteristics of the populations in the receiving water body as well as the physical characteristics of

the discharge. In acknowledgement of the unique characteristics of the aquatic ecosystem involved, this report specifically addresses the effects of Cumberland Steam Plant's heated effluent on the fish community in Barkley Reservoir. The objectives of the study were to (1) determine the influence of the thermal effluent on the distributions of Barkley Reservoir fish populations in the vicinity of the steam plant, (2) assess the impacts of heated discharge on selected reservoir fish populations in terms of certain life history parameters, (3) determine the potential for appreciable mortality of adult fish due to cold shock resulting from the sudden interruption of steam plant operations, and (4) characterize the status of the fish community of Barkley Reservoir in relation to similar communities in adjacent reservoirs.

30533 **(PB—81-119687) Economic analysis for the proposed revision of steam-electric utility industry effluent limitations guidelines.** Wasserman, J. (Environmental Protection Agency, Washington, DC (USA). Office of Planning and Evaluation). Sep 1980. 47p. NTIS, PC A03/MF A01.

This report provides an economic and financial analysis of the proposed revisions to the effluent limitation guidelines for the Steam Electric utility Industry. It considers the economic effects associated with BAT and pretreatment standards for once-through and recirculating cooling water as well as NSPS for both cooling water streams and fly ash transport water. The analysis was conducted at both the plant and national levels. Although the proposed regulations will require that the industry spend up to $80 million annually to comply and its cumulative capital expenditures will increase by $200 million over the period 1980-1995, these increases are very small relative to the baseline industry costs. The analysis concludes that the proposed regulations will not significantly add to the costs of generating electricity.

30534 **(PNL—3842) Evaluation of flyash surface phenomena and the application of surface analysis technology. Summary report: Phase I.** Smith, R.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 66p. NTIS, PC A04/MF A01. Order Number DE81029106.

The factors governing the formation of flyash surfaces during and following coal combustion are reviewed. The competing chemical and physical processes during the evolution of inorganic material in coal during combustion into flyash are described with respect to various surface segregation processes. Two mechanisms leading to surface enrichment are volatilization-condensation processes and diffusion processes within individual flyash particles. The experimental evidence for each of these processes is reviewed. It is shown that the volatilization-condensation process is the major factor leading to trace element enrichment in smaller flyash particles. Evidence also exists from surface analyses of flyash and representative mineral matter that diffusion processes may lead to surface enrichment of elements not volatilized or cause transport of surface-condensed elements into the flyash matrix. The semiquantitative determination of the relative importance of these two processes can be determined by comparison of concentration versus particle size profiles with surface-depth profiles obtained using surface analysis techniques. A brief description of organic transformations on flyash surfaces is also presented. The various surface analytical techniques are reviewed and the relatively new technique of Static-Secondary Ion Mass Spectroscopy is suggested as having significant advantages in studies of surfaces and diffusion processes in model systems. Several recommendations are made for research relevant to flyash formation and processes occurring on flyash surfaces.

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REFER ALSO TO CITATION(S) 30116, 30761, 30767, 30771

30535 **(AD-A—091672) Safe underwater electrical power. Report for Oct 78-Sep 79.** Tucker, L.W.; Nelson, F.E. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Feb 1980. 27p. NTIS, PC A03/MF A01.

The Civil Engineering Laboratory is developing a unique and improved ground fault detection and diver protection system that will allow safe electrical power transmission underwater. The system is designed to sense and shut down all electrical power on ground fault currents of 4.5 mA or more in 10 ms. The shutdown is performed in two steps: (1) first a signal initiated by a leakage to ground in the transmission cable or load trips the main power circuit breaker, and (2) a set of triacs are turned on which are connected to short the power lines. The circuit breaker is backed up by conventional fuses that would blow quickly from the short circuit current if the breaker should fail. This sequence of events is designed to occur in approximately 10 ms. The design of the system is adaptable to electric power transmission systems supplying up to 100 kW. The paper reviews electrical safety criteria relative to divers, describes the Civil Engineering Laboratory's protection concept, and presents laboratory test results from an experimental system protection a 30-kW underwater load.

30536 **(BNL—29900) Cryogenic testing of 100-m superconducting power transmission test facility.** Gibbs, R.J.; Jensen, J.E.; Thomas, R.A. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 8p. (CONF-810835—2). NTIS, PC A02/MF A01. Order Number DE81028331.

From 1981 cryogenic engineering conference; San Diego, CA, USA (10 Aug 1981).

The final tests of the cryogenic system designed to cool the test facility for 100 m superconducting, power transmission cables have been completed. Since the completion of previously reported tests in a three-expander configuration, the system was modified to incorporate a fourth turbine placed remotely from the refrigerator at the far end of the load. In this configuration the load, consisting of the superconducting cables and their containment vessel, becomes a long (> 100 m) counterflow heat exchanger with internal heat generation. The results of these tests are presented with discussion of the operation, equipment performance, and possible areas for improvement. The actual operation of the system was quite smooth and required a minimum of manpower. The newly installed automatic control systems on the turbines performed perfectly although, except for speed control, they had little to do. The computers used to monitor the temperatures, pressures, and flows worked very well. It was noted that this system with its large mass of supercritical helium was extremely stable against short-term large perturbations, all of which are damped and disappear into this heat sink. No system or thermo-acoustic oscillations were observed and those temperature oscillations which were observed due to a change in operating mode, etc., were obviously quickly damped and disappeared.

30537 **(CONF-810720—2) Role of electron swarm studies in the development of gaseous dielectrics.** Christophorou, L.G. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE81026349.

From 2. international swarm seminar; Oak Ridge, TN, USA (22 Jul 1981).

Recent knowledge provided by swarm studies allowing control of the number densities and energies of free electrons in electrically stressed gases is highlighted. This knowledge aided the discovery of new gas dielectrics and the tailoring of gas dielectric mixtures. The role of electron attachment in the choice of unitary gas dielectrics or electronegative components in dielectric gas mixtures, and the role of electron scattering at low energies in the choice of buffer gases for mixtures is outlined.

30538 **(CONF-810734—1) DC dielectric strengths of fluorinated benzenes and the stored-energy theory.** Smith, D.H.; Bouldin, D.W.; Christophorou, L.G. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE81026515.

From 7. international conference on conduction and breakdown in dielectric liquids; Berlin, F.R. Germany (27 Jul 1981).

A systematic study of the hydrofluorobenzenes to quantify the effect of liquid polarity on the dielectric strength is described. Two important relationships are introduced: (1) dielectric strength decreased as the number of fluorines increased by the relation O/sub S_1/ = S_1 - 1.9$_2$f; and (2) dielectric strength decreased as the dielectric constant (or capacitance) increased by the relation O/sub S_1/ = (1/d)$\sqrt{}$2U/C[1 - e/sup -2 tau/RC/]. The first of these two

equations is empirical. The second is based on a postulate that breakdown occurs at a critical value of the energy stored in the test apparatus, which is the same for all of hydrofluorobenzenes. Further experiments on these and other compounds are needed to test the validity of these ideas. Once validated, they should be of considerable use in the design of electrical power delivery equipment.

30539 **(DOE/CE/29006—1) Analysis and measurement of electric fields from dc transmission lines.** (General Electric Co., Pittsfield, MA (USA)). May 1981. Contract AC01-77ET29006. 150p. NTIS, PC A07/MF A01. Order Number DE81026331.

Research was performed to investigate the near-field effects which could occur near or within the right-of-way of HVDC, up to 750 kV, transmission lines. The project activities included: design and construction of test facilities, development of measuring techniques and instrumentation; measurements of wind and humidity effects on ion current density, electric field, and corona current; measurements of voltages and currents induced on vehicles (van, bus, tractor); measurements of corona on grounded objects; shield investigation; and the development of experimental and mathematical models. Each activity and the results obtained are described. It was found that ion current densities at ground level are very dependent on wind and relative humidity with no current 2 to 4 times as great in rain as compared with fair weather; the electric field was dependent on wind conditions but showed no clear dependence on relative humidity; corona current was dependent on relative humidity; voltages induced on vehicles near DC lines were of negligible concern; and shielding can be achieved by a grid of grounded wires. (LCL)

30540 **(DOE/ET/29185—20) System studies of integrated ac/dc systems incorporating HVDC circuit breakers.** (Wisconsin Univ., Madison (USA). Extension). 1980. Contract AS02-78ET29185. 15p. NTIS, PC A02/MF A01. Order Number DE81029036.

This report contains a work statement for a study in which the objective is to examine the dynamic relationships of integrated ac/dc power systems containing high voltage direct current circuit breakers; a one-page discussion of the effects of a planned HVDC system on interconnected ac systems located in the general vicinity; and a quarterly progress report for a study aimed at identifying hardware developments and systems applications which can exemplify cost and operational advantages on integrated ac/dc power systems. (LCL)

30541 **(DOE/ET/29303—T1) Basic study of transient breakdown voltage in solid dielectric cables. Final report.** Bahder, G.; Sosnowski, M.; Katz, C. (Cable Technology Labs., Inc., New Brunswick, NJ (USA)). Sep 1980. Contract AC01-78ET29303. 267p. NTIS, PC A12/MF A01. Order Number DE81027495.

A comprehensive review of the technical and scientific publications relating to crosslinked polyethylene (XLPE) and ethylene propylene rubber (EPR) insulated cables revealed that there is very little known with respect to the life expectancy, the final factory voltage test background and the mechanism of voltage breakdown of these cables. In this study a new methodology for the investigation of breakdown voltages of XLPE and EPR insulated cables was developed which is based on the investigation of breakdown voltages at various voltage transients such as unipolarity pulses and dual-polarity pulses, and a.c. voltage at power and high frequency. Also, a new approach to statistical testing was developed which allows one to establish a correlation among the breakdown voltages obtained with various voltage transients. Finally, a method for the determination of threshold voltage regardless of the magnitude of apparent charge was developed. Extensive statistical testing of breakdown voltages was conducted using: impulses with front durations from approximately 1.5 to 1000 μs and times to half-values from 40 to 3000 μs; dual-polarity pulses consisting of d.c. voltage and standard impulse of opposite polarity; combined a.c. and d.c. voltages; and a.c. voltages at power and high frequencies. Based on the results of this testing, a model of breakdown and electrical aging of XLPE and EPR insulated cables was developed as well as life expectancy characteristics for high voltage stress XLPE insulated cables operated in a dry environment at room temperature and at 90°C. Life expectancy characteristics for EPR insulated cables are approximated. A test procedure including requirements for full-reel factory voltage withstand and partial discharge testing of finished XLPE and EPR insulated cables is proposed. Cables that pass the proposed tests will exhibit a smaller rate of failure in service than cables tested in accordance with present practices.

30542 **(DOE/TIC—1027653) Biomedical effects associated with energy-transmission systems: effects of 60-Hz electric fields on circadian and ultradian physiological and behavioral functions in small rodents. Period covered: January 1, 1980-December 31, 1980.** Ehret, C.F.; Rosenberg, R.S.; Sacher, G.A.; Duffy, P.H.; Groh, K.R.; Russell, J.J. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 85p. NTIS, PC A05/MF A01. Order Number DE81027655.

The effects of extremely low frequency (ELF) electric fields on transient patterns of circadian rhythms of physiological and behavioral end points are being investigated. This project is developing a data base to determine the exposure conditions that disturb the highly characteristic waveforms of ultradian, circadian, and infradian rhythms. The project has taken the following approach: (1) small rodents are exposed to well-defined ELF horizontal or vertical electric fields at nominal field strengths as high as 100 kV/m in individual residential facilities; (2) exposures follow a variety of schedules ranging from brief (one minute) to continuous, and including variations of circadian periodicities; (3) end points such as metabolism, activity, core body temperature, operant performance, and weight gain are continuously recorded for long intervals by microprocessor-controlled data acquisition systems; (4) the characteristic waveforms are analyzed by several statistical procedures for deviations from their unperturbed ultradian and circadian patterns; and (5) when and if exposures induce distrubances of the patterns, a search for concomitant neurochemical changes will begin. The following conclusions were reached: under a variety of exposure conditions the circadian regulatory system of the rat remained intact; brief ELF exposures at field strengths above 35 kV/m, presented during the inactive phase of the circadian cycle, produced a transient arousal in mice, characterized by increases in motor activity, carbon dioxide production, and oxygen consumption; the transient arousal habituated rapidly; no significant effects were seen in the second, third, or fourth exposure of mice using a one hour on, one hour off protocol; and there were no circadian aftereffects of the intermittent ELF stimulus in mice, based on measuresof rhythms of activity and gas metabolism.

30543 **(EPRI-EL—1894) Backfill materials for underground power cables. Phase II. Backfill treatments, heat and moisture flow analyses, and field tests. Interim report.** Mitchell, J.K.; Abdel-Hadi, O.N.; Chan, C.K.; Kao, T.C.; McMillan, J.C. (California Univ., Berkeley (USA). Dept. of Civil Engineering). Jun 1981. 311p. NTIS, PC A14/MF A01. Order Number DE81903929.

The objective of these studies was the development of soil treatments which can decrease the thermal resistivity and increase the thermal stability of trench backfills around buried power cable systems. Laboratory thermal needle resistivity studies were made of numerous proposed backfill additives. Primary emphasis was placed on the effectiveness and durability of wax additives, the leaching resistance of a polymer additive, and the effectiveness of asphalt and other petro-additives. A one-dimensional explicit finite difference program using the Philip and de Vries Theory was developed to evaluate the coupled heat and moisture flows in a layered soil system. A field test facility consisting of ten 10 ft long simulated buried cable sections was constructed. Six were subjected to thermal loadings prior to writing this report. The field test sections are instrumented with thermocouples and fringe capacitance moisture probes. Comparisons of measured temperature profiles in the trenches and those predicted by a finite element heat conduction program are presented. Agreement is generally good. A comparison is also given of measured moisture profiles and those calculated by the one-dimensional model for one of the test sections. The agreement is not good, and the discrepancy may be due to the restriction of flow to one dimension. The predictions seems sensitive to small changes in backfill density and fines content. Operation of the field test sections to establish the long-term effectiveness of the backfill treatments continue. So far the treatments appear to be functioning well.

30544 (EPRI-EL—1916) Light-fired thyristor development. Interim report. Schlegel, E.S.; Strycula, E.C.; Lowry, L.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Jul 1981. 96p. NTIS, PC A05/MF A01. Order Number DE81903932.

A light-fired thyristor switch was demonstrated in one phase of a static volts-amperes-reactive generator and is presently under extended test at Minnesota Power and Light Company. The building of this 13.8-kV, bidirectional, 1200-A rms, solid-state switch required the development of the thyristor element and its special package, a light system consisting of laser diodes and a light distribution harness, and a special monitoring and protecting control circuit to protect the switch against various conditions under which it might not function safely. The switch is entirely self-contained and replaces the electrically gated version with no need for changes in the circuit to which it is connected. The report gives details on the development of each of the novel parts of the system; on the testing of each part of the system; and on the building, installation, and early evaluation of the switch.

30545 (EPRI-EL—1948) Nb_3Ge-based 1-m power-transmission cable: material development, cable fabrication, and cable-performance tests. Final report, July 1981. Maley, M.P.; Newkirk, L.R.; Thompson, J.D.; Valencia, F.A. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 65p. NTIS, PC A04/MF A01. Order Number DE81026297.

Since its discovery in 1973 as the superconductor with the highest known transition temperature (T/sub c/ $\geq$ 23 K), Nb_3Ge has offered the possibility of operating temperatures $\geq$ 14 K, for superconducting devices. For application to the transmission of electric power, higher operating temperatures imply increased efficiency and lower capital costs. In the first two phases of our program to develop a Nb_3Ge conductor for power transmission applications we developed a chemical vapor deposition CVD process for producing long continuous lengths of Nb_3Ge-clad tape conductors with critical current densities J/sub c/ and low ac losses suitable for power transmission at T $\geq$ 12 K. In this report, we describe the fabrication and testing of a 1-m-long coaxial cable constructed from 87 m of our Nb_3Ge-clad tape. Short sample measurements indicated that all of this tape exceeded the specification that J/sub c/ (13.8 K) $\geq$ 1.8 x 10^6 A/cm^2. The cable was wound in the double-helix design of the Brookhaven National Laboratory, BNL, power transmission project. AC current tests were performed at BNL where the cable carried the design current amplitude of 6000 A but exhibited ac losses from 7 to 13 K that were 50 to 100 greater than were expected from short sample measurements. These losses were attributed to a combination of instrumental problems associated with ac loss measurements in 1-m cables of the double helix design, end effects, and possible tape damage. The results of a materials development program aimed at improving the superconducting performance of our Nb_3Ge material is also described.

30546 (EPRI-EL—1953) Feasibility study of the use of an environmental chamber for the examination of transmission-line electric-field and corona effects. Final report. Sebo, S.A.; DeVore, R.V.; Kasten, D.G. (Ohio State Univ., Columbus (USA). Dept. of Electrical Engineering). Jul 1981. 48p. NTIS, PC A03/MF A01. Order Number DE81903933.

The report investigates the feasibility of an environmental chamber combined with model-scale and full-scale (with reduced spacings) conductors for the examination of transmission line electric field and corona effects. The feasibility of tests in a 5m x 5m x 6m (length) environmental chamber related to ground level electric field strength, corona starting voltage, conductor surface conditions, corona mechanisms, corona losses, ozone emission, audible noise, radio noise, and DC corona phenomena for changes in energizing voltages, geometry, conductor types and materials, and atmospheric conditions are reviewed. Environmental chamber design considerations and preliminary specifications are also outlined with a review of supply requirements and guidelines for instrumentation. The recommendation of this report is positive: the use of an environmental chamber combined with model-scale and full-scale (with reduced spacings) conductors for the examination of transmission line electric fieldand corona effects is feasible and meaningful. Such a special-purpose environmental chamber is not a replacement of full-scale test lines but it is a new tool that serves development and design. The performance of the chamber is comparable to that of a high-voltage outdoor test cage; however, the scope of experiments in the chamber is much greater than in an outdoor test cage.

30547 (LA-UR—81-2296) 30-MJ superconducting magnetic-energy storage for BPA transmission-line stabilizer. Schermer, R.I. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810833—3). NTIS, PC A02/MF A01. Order Number DE81028701.

From Mechanical, magnetic, and underground energy storage 1981 annual contractors' review meeting; Washington, DC, USA (24 Aug 1981).

The Bonneville Power Administration operates the transmission system that joins the Pacific Northwest and southern California. A 30 MJ (8.4 kWh) Superconducting Magnetic Energy Storage (SMES) unit with a 10 MW converter can provide system damping for low frequency oscillations. The unit is scheduled to operate in 1982. Progress during FY 81 is described. The coil is complete. All major components of the electrical and cryogenic systems have been received and testing has begun. Computer control hardware is in place and software development is proceeding. Support system components and dewar lid are being fabricated and foundation design is complete. A contract for dewar fabrication is being negotiated.

30548 (ORNL/TM—7862) High-voltage research (breakdown strengths of gaseous and liquid insulators) and environmental effects of dielectric gases. Semiannual report, October 1, 1980-March 31, 1981. Christophorou, L.G.; James, D.R.; Pai, R.Y. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 170p. NTIS, PC A08/MF A01. Order Number DE81027885.

Electron attachment has been measured to several chlorofluoroethanes and chloroethylenes in both argon and nitrogen at relatively high pressures. The most recently available electron drift velocity data were used to refine calculated electron momentum transfer cross sections in argon, and these were used to refine the electron attachment rates for 1,1-dichloroethane. Electron attachment rates were measured for several chlorocarbons in argon. Electron attachment rates for n-C_5F_{12} have been extended to higher energies in N_2, and measurements of the electron attachment rate for n-C_8F_{12} have been made as a function of the total argon pressure. Information is presented on: the basic physics of electron attachment to dielectric gas molecules; dielectric strengths of gases and gas mixtures; impulse and applied studies; synthesis of new dielectric gases; and environmental effects. Studies of liquid dielectrics are discussed. Data are reported for space charges produced by impurity water in benzonitrile. An equation has been derived for space-charge injection by electrolysis of impurities. This equation gives the spatial distribution of the space-charge density as a function of the electrode gap and the fraction of the limiting current that is conducted by the liquid. (LCL)

30549 Wave propagation in a dc superconducting cable--1. Analysis. Chowdhuri, P.; Mahaffy, M.J. (Los Alamos Sci Lab, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems ;* **PAS-100**: No. 2, 673-679(Feb 1981).

This paper discusses the theory of wave propagation in a multiconductor cable system and describes the response of a dc superconducting cable of a specific design to transient voltages. The effects of parametric changes in the system as well as in the cable design, including those of dc conventional cables, are discussed in a companion paper. Paper No. 80 SM 617-1.

30550 Wave propagation in a dc superconducting cable--2. Parametric effects. Chowdhuri, P.; Mahaffy, M.A. (Los Alamos Sci Lab, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems ;* **PAS-100**: No. 2, 680-690(Feb 1981).

Wave propagation is studied in several designs of dc superconducting cables. DC conventional cables are also included for the purpose of comparison. The effects of several parameters were studied to limit transient voltages; these are voltage rating, number of conductors, conductor resistances, earth resistivity, terminal

grounding resistances of the "grounded" conductors at the origin and dielectric constants. Voltage ratings, conductor resistances, and terminal grounding resistances seem to influence the transient performance of a multiconductor cable significantly. The effect of finite earth resistivity is insignificant. Paper No. 80 SM 618-9. 7 refs.

30551 **Power and the environment: a case study of the siting of 765-kilovoit transmission line.** Burstein, K. (New York Public Service Commission, Albany). pp 111-130 of Environment, energy, public policy: toward a rational future. Axelrod, R.S. (ed.). Lexington, MA; D.C. Heath and Company (1981).

From Conference on energy and environment; Garden City, NY, USA (8 Jun 1979).

In 1973, the Power Authority of the State of New York filed an application to construct a 765-kV transmission line to bring Canadian-produced hydroelectric power to New York City. The New York State Public Service Commission, (PSC) held hearings on this case, which was concluded in 1978. This paper discuses the case and the PSC decisions. 60 references. (DLC)

30552 **Derivation of the Brayton-Moser equations from a topological mixed potential function.** Massimo, F.M.; Kwatny, H.G.; Bahar, L.Y. (Drexel Univ., Philadelphia, PA). Contract ET-78-5-01-3088. *Journal of the Franklin Institute ;* **310**: No. 4/5, 259-269(Oct 1980).

A topological mixed potential function, P*/sub T/, is defined and shown to be an exact differential. From P*/sub T/, Brayton-Moser equations are obtained from topological relationships of the network and the constitutive relationships of the elements. A relationship between P*/sub T/ and Brayton-Moser's mixed potential function, Q, is developed.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 30730

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 30639, 30646

30553 **(DOE/ET/34215—18) Process development and fabrication for sphere-pac fuel rods.** Welty, R.K.; Campbell, M.H. (Consumers Power Co., Jackson, MI (USA); Exxon Nuclear Co., Inc., Richland, WA (USA); Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC02-76ET34215. 60p. (XN-NF—555). NTIS, PC A06/MF A01. Order Number DE81028259.

Uranium fuel rods containing sphere-pac fuel have been fabricated for in-reactor tests and demonstrations. A process for the development, qualification, and fabrication of acceptable sphere-pac fuel rods is described. Special equipment to control fuel contamination with moisture or air and the equipment layout needed for rod fabrication is described and tests for assuring the uniformity of the fuel column are discussed. Fuel retainers required for sphere-pac fuel column stability and instrumentation to measure fuel column smear density are described. Results of sphere-pac fuel rod fabrication campaigns are reviewed and recommended improvements for high throughput production are noted.

30554 **(DOE/ET/34215—20) Description and characterization of BRPR series S-0, S-1, S-2, S-3, and S-4 demonstration fuel rods.** Welty, R.K. (Battelle Pacific Northwest Labs., Richland, WA (USA); Exxon Nuclear Co., Inc., Richland, WA (USA)). Jul 1981. Contract AC02-76ET34215. 345p. (XN-NF—579). NTIS, PC A15/MF A01. Order Number DE81028786.

This report describes the process development, fabrication, and pre-irradiation characterization of the demonstration fuel rods for irradiation in the Big Rock Point Reactor as part of the DOE-sponsored Fuel Performance Improvement Program (FPIP). The fuel rods represent advanced designs that are expected to exhibit improved performance with respect to pellet-cladding-interaction and the attainment of extended burnup. Whereas other design variations are described, the primary fuel concepts being evaluated as part of the FPIP are an annular-coated-pressurized design and, at a more modest level, a sphere-pac design. A solid-pellet reference design provides the basis for comparing irradiation behavior.

30555 **(EPRI-NP—1884) Evaluation of the effects of heat treatment on the passive behavior of Ni-Cr-Fe alloys in high-temperature water.** Morris, P.E. (International Nickel Co., Inc., Suffern, NY (USA). INCO Research and Development Center). Jun 1981. 206p. NTIS, PC A10/MF A01. Order Number DE81903816.

Five electrochemical test programs were completed to investigate the effects of thermal treatment, environmental variations and stress on the corrosion resistance of INCONEL alloys 600 and 690 in PWR related dilute caustic environments in the temperature range between 260 to 316°C. Several of the tested specimens were selected to characterize the corrosion product surface scales. The fundamental electrochemical corrosion behavior of these systems is described and a possible mechanism of surface scale formation is discussed. One test program was conducted to investigate the stress corrosion resistance of INCONEL alloys 600 and 690 in recirculated water containing 0.2 ppM oxygen at 289°C. In addition to stress corrosion test results, the effects of dissolved oxygen on the corrosion potential are presented.

30556 **(EPRI-NP—1952) Assessment of precision gamma scanning for inspecting LWR fuel rods. Final report.** Phillips, J.R.; Barnes, B.K.; Barnes, M.L.; Hamlin, D.K.; Medina-Ortega, E.G. (Los Alamos Scientific Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 81p. NTIS, PC A05/MF A01. Order Number DE81025478.

Reconstruction of the radial two-dimensional distributions of fission products using projections obtained by nondestructive gamma scanning was evaluated. The filtered backprojection algorithm provided the best reconstruction for simulated gamma-ray sources, as well as for actual irradiated fuel material. Both a low-burnup (11.5 GWd/tU) light-water reactor fuel rod and a high-burnup (179.1 GWd/tU) fast breeder reactor fuel rod were examined using this technique.

30557 **(EPRI-NP—1954) Analysis of fission gas release measurements using the COMETHE IIIJ and FCODE-Alpha computer codes. Final report.** Leppert, G.; Rayes, L.; Rumble, E.; Stuart, R. (Science Applications, Inc., Palo Alto, CA (USA)). Jul 1981. 77p. NTIS, PC A05/MF A01. Order Number DE81903766.

Fission gas release predictions from FCODE-Alpha and COMETHE IIIJ were compared with experimental data from a representative group of light water reactor (LWR) fuel rods and with each other. In the first phase of the study, standard versions of the codes obtained from the Electric Power Software Center were compared with data from 36 rods. A modified version of COMETHE was used in the second phase of the study, which compared measurements from some of the same rods studied in the first phase, as well as with an additional 27 rods. Fission gas release predictions from both codes show substantial deviation from experimental measurements, and additional well-qualified data from LWR's is needed for comparison. Unpressurized rods experience significant degradation in heat transfer across the fuel-to-cladding gap as the lower thermal conductivity fission gases mix with the helium.

30558 **(PNL-TR—414) Radioactivity releases from fuel elements stored in the KRB-A storage pool over prolonged periods of time.** Eickelpasch, N.; Wilstermann, H.; Fettel, W.; Huebscher, D. Translated from *ATW, Atomwirtschaft, Atomtechnik ;* **26**: No. 4, 242-246(Apr 1981). 17p. NTIS, PC A02/MF A01. Order Number DE81024395.

The whole core of the KRB-A nuclear power plant was unloaded in 1977 into the fuel element storage pool as a function of time and temperature was determined with an extensive monitoring program, in one case with a disconnected clean up plant and in the second case with a disconnected coolant in addition. Aerosol measurements were undertaken above the middle of the storage pool.

The principal carriers of radioactivity in the pool water were the radionuclides Cs-134, Cs-137 and Co-60. The monitoring period is the longest yet to be devoted to this question. The measured values found give information on whether a longer storage of fuel elements, also with defective fuel rods, is possible without overtaxing the existing cleanup system.

30559 **Plastic fracture mechanics prediction of fracture instability in a circumferentially cracked pipe in bending--1. J-integral analysis.** Zahoor, A.; Kanninen, M.F. (Battelle, Columbus Lab, Ohio). *American Society of Mechanical Engineers, [Paper] ;* No. 80-WA/PVP-3, 1-8(Nov 1980).

A method of evaluating the J-integral for a circumferentially cracked pipe in bending is proposed. The method allows a J-resistance curve to be evaluated directly from the load-displacement record obtained in a pipe fracture experiment. This method also permits an analysis for fracture instability in a circumferential crack growth using a J-resistance curve and the tearing modulus parameter. The importance of using a J-resistance curve that is consistent with the type of constraint for a given application is emphasized. 18 refs.

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REFER ALSO TO CITATION(S) 30553, 30555, 30556, 30557, 30618, 30639, 30645, 30646

30560 **(CONF-810814—7) Water-decontamination process-improvement tests and considerations.** Collins, E.D.; Campbell, D.O.; King, L.J.; Knauer, J.B. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 33p. NTIS, PC A03/MF A01. Order Number DE81028064.

From 91. national meeting of the American Institute of Chemical Engineers; Detroit, MI, USA (16 Aug 1981).

Previous tests showed that the SDS process was suitable for removal of bulk radioactive contaminants (cesium and strontium) from the TMI-2 water. However, the polishing treatment did not provide water which could meet interim storage specifications. Further tests have identified modifications to provide sufficient decontamination and permit increased sorbent loadings.

30561 **(EPRI-NP—1875) Development of sensors and instrumentation for the TMI-2 OTSG tube vibration measurements program.** Anthony, J.M.; Olszewski, J.S. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.). Jun 1981. 168p. NTIS, PC A08/MF A01.

The Babcock & Wilcox Company installed sensors in a once-through-steam-generator in the Three Mile Island Unit 2 plant to determine the vibrational response of selected steam generator tubes under various operating conditions, both normal and transient. Additional external sensors provided data which were used with flow and operating condition data to permit correlation to the tube response. This program demonstrates the feasibility of installing biaxial accelerometers at various depths within steam generator tubes along with up to four weldable strain gages in a single tube at one elevation.

30562 **(EPRI-NP—1876-Vol.1) Flow-induced vibration analysis of Three Mile Island Unit-2 once-through steam generator tubes. Volume 1. Final report.** Johnson, J.R.; Brown, J.C.; Harris, C.E.; McGuinn, E.J.; Simonis, J.C.; Thoren, D.E. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.). Jun 1981. 85p. NTIS, PC A05/MF A01. Order Number DE81903813.

Tube responses to flow-induced vibration were measured in the top two spans and the tenth span in the B once-through steam generator at Three Mile Island, Unit 2. This program evaluated the effects of flow-induced biration of OTSG tubes during steady-state and transient operation. Twenty-three tubes were instrumented with accelerometers and strain gages in tubes located along the open lane, in the bundle, and at the tenth span. Tube displacements, frequencies, dynamic strains, and mode shapes were determined during steady-state and transient operation. Pressure sensors were installed in the OTSG to measure pressure fluctuations and plant parameters, which were recorded for correlation with tube response. Data analysis results indicate that the steady-state tube response increases with increasing reactor power, with the maximum response (12 mils peak to peak at midspan) at the outer perimeter of the generator in the 16th span.

30563 **(EPRI-NP—1888) Flow-induced vibration analysis of Oconee-2B OTSG tubes. Final report.** Simonis, J.C.; Brown, J.C. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.). Jun 1981. 127p. NTIS, PC A07/MF A01.

The vibratory response of four tubes in the B loop of the once-through steam generator (OTSG) has been measured at the Oconee 2 nuclear power station during steady-state operation. The responses of the tubes were measured by biaxial accelerometers installed in the upper span of three tubes adjacent to a missing lane of tubes (open lane) and a biaxial accelerometer installed in one tube lane toward the interior of the tube bundle (off lane). Data were analyzed to identify displacement, frequency, and damping trends associated with normal operation. These trends were then used to relate normal, steady-state power levels to anomalous tube responses. Also, the displacement frequency and damping trends from this measurement program were compared to similar results from the measurement program conducted on the Three Mile Island OTSG.

30564 **(EPRI-NP—1941) Steam-generator sludge-pile model-boiler testing. Final report.** Baum, A.J.; Greaney, P.K. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Strategic Operations Div.). Jul 1981. 104p. NTIS, PC A06/MF A01.

Nuclear plant data have indicated that localized tube corrosion can occur within sludge piles found on the tubesheet faces of steam generators. It is speculated that this corrosion is caused by the concentration of chemical species dissolved in the bulk secondary fluid. The work of this project consisted of characterizing the physical and chemical properties of actual sludges, developing simulated sludges, determining the extent of dryout in the sludge (which can be related to chemical concentration phenomena), and developing an analytical model for determining the position of dryout within the sludge. Results and the mathematical model indicate that only small amounts of sludge (heights on the order of 0.5 inch) can lead to dryout. This dryout region appears to be insensitive to sludge morphology and applied heat flux.

30565 **(EPRI-NP—1944) Optical scanner system for internal inspection of steam generator tubes. Final report.** Hall, G.D.; Meckstroth, E.A.; Orphan, V.J. (Science Applications, Inc., San Diego, CA (USA)). Jul 1981. 127p. NTIS, PC A07/MF A01.

The goals of this program are to further evaluate the basic capabilities of the prototype optical scanner system and to design and fabricate both an improved low-resolution scanner and a high-resolution scanner and data acquisition system. A low-resolution scanner system was assembled, based on the design of the prototype scanner, with improvements in the mechanical and optical design, as well as the addition of a data acquisition and display system for accurate and realistic presentation of the image. Improving on the design of the low-resolution system, a high-resolution (720-element detector array) scanner was then designed and fabricated. The data acquisition and display system was also upgraded during this phase of development. The resultant system will image a circumferential band on the inside surface of a 0.670 in (17mm) tube to a precision of 480 picture elements. The performance evaluation of the two scanners included resolution tests and observation of simulated and actual defects in steam generator tubes. These test results are compared with similar evaluations of the prototype scanner.

30566 (EPRI-WS—80-136, pp 1.1-1.7) **Workshop on cracking of Alloy 600 U-bend tubes in steam generators.** Paine, J.P.N. (Electric Power Research Inst., Palo Alto, CA). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

The urgency of evaluating the current state of knowledge relating to pure water cracking of Alloy 600 is apparent. The sus-

ceptibility of Alloy 600 in regions of high stress concentration is a major concern to a number of utilities who are members of the Steam Generator Owners Group. Resolution of the various questions which have been posed, relating to initiation time, crack propagation rate, safety concerns, and in-situ NDE characterization need to be addressed and were considered in preparing the agenda and structuring this workshop.

30567 (EPRI-WS—80-136, pp 3.1-3.6) **Summary of operating plant experience and U-bends.** Fletcher, W.D. (Westinghouse Electric Corp., Pittsburgh, PA). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

Since 1977, there have been a number of occurrences of steam generator tube leakage events found to be due to wall penetration in the smallest, Row 1, U-bends. These events are not associated with tube denting that previously (1976) characterized the condition observed at Surry 1, 2 and Turkey Point 4. Excluding these early observations, the operating plants that have experienced U-bend leakage with the year of occurrence are listed. None of these plant steam generators show indications of tube denting at the uppermost tube support plate. A review of manufacturing is in progress for the Row 1 U-bends in each of the steam generators showing tangent point leakage or eddy current indications.

30568 (EPRI-WS—80-136, pp 4.1-4.18) **Operating history and field inspection results of Trojan steam generators.** Carter, J.W. (Portland General Electric, Beaverton, OR). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

The Trojan Nuclear Plant is a four-loop Westinghouse Pressurized Water Reactor facility with a Nameplate Rating (Gross MWe) of 1216 and Maximum Dependable Capacity (Net MWe) of 1080. The initial power generation took place in December 1975, and the plant was declared commercial in May 1976. Steam generator eddy - current - testing results are presented, and tube removal procedures are described.

30569 (EPRI-WS—80-136, pp 5.1-5.7) **Status report on the destructive and non-destructive examinations of U-bends removed from Trojan steam generator D.** Aspden, R.G. (Westinghouse Electric Corp., Pittsburgh, PA). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

The last status report on the non-destructive examination of U-bends removed from Trojan steam generator D was dated July 7, 1980. As part of this activity, the measurement of wall thicknesses on selected U-bends was planned using an ultrasonic gage. These readings were not made because reproducible results could not be obtained using water as the coupling fluid which was necessary to avoid contamination. Three tubes from the same heat were selected for destructive examination at Westinghouse: one leaking U-bend (R1-C6) and two tubes with no indications (R1-C10 and R1-C22). Results of the examination procedure are presented. The non-destructive examination results from the July 7, 1980 report for 29 U-bends are included.

30570 (EPRI-WS—80-136, pp 6.1-6.13) **U-bend cracking at Doel 2.** Dobbeni, D.P.; Stubbe-Leroy, J.R.; van Melsen, C.E. (Laborelec, Rhode-St. Genese, Belgium). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

Two Westinghouse 390 MWe PWR have been in operation since 1975 (units 1 and 2). The accident happened in June 1979, during a re-start of Unit 2. The pressure in the primary loop began suddenly to drop (about 0.2 MPa/min, i.e. 28 psi/min). In the secondary loop, the level of the water increased quickly in SG B and the activity of the blow-down reached the maximum indication. A primary-to-secondary leak in the steam generator was indicated and later estimated at 50 m^3/h or 40 metric tons per hour. Examination of the leaking tube is described.

30571 (EPRI-WS—80-136, pp 7.1-7.22) **Review of U-bend cracking as a result of tube denting.** Morgan, E.P. (Westinghouse Electric Corp., Pittsburgh, PA). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

As has been previously reported, one instance of leakage in the Row 1 U-bend region was the result of the tube denting phenomenon. Denting is defined as a local tube diameter reduction due to a corrosion product buildup between the tube and the surrounding carbon steel support plate. The clearance between the tube and the support is approximately 14 mils on the diameter. In the case of ingress of corrosive impurities, this annulus becomes filled with carbon steel corrosion products adjacent to the Inconel 600 tubing. As the steel corrodes, the volume of the corrosion products press inward on the tubing producing a dent. Denting of the tube also causes in-plane expansion of the support plate. Support plates are mostly tube holes and flow holes joined by narrow ligaments. In the center of each plate is what is termed a tube lane flow slot. Flow slot closure due to the in-plane expansion is monitored in plants as one means of documenting the extent and rate of denting.

30572 (EPRI-WS—80-136, pp 8.1-8.4) **Discussion of corrosion mechanisms.** Paine, J.P.N. (Electric Power Research Inst., Palo Alto, CA). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

This appendix summarizes discussions directed toward developing an understanding of the mechanisms of cracking and factors which may contribute to both crack initiation and propagation. Discussions considered five mechanisms originally postulated and ranked in order of likelihood of occurrence; primary side initiated pure water cracking; secondary side initiated cracking; hydrogen embrittlement; pitting - OD/ID initiated; and intergranular attack - secondary side initiation.

30573 (EPRI-WS—80-136, pp 9.1-9.33) **Stresses in bent inconel tubes.** Cloud, R.L. (Robert L. Cloud Associates, Inc., Berkeley, CA). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

Stresses in the bend region of steam generator tubes are categorized as load induced and residual. Load induced stresses result from the applied pressure and differential temperatures in the steam generator. Residual stresses result from the forming and bending operations performed on the tubes during the manufacturing process. The magnitude and distribution of load induced stresses in the short radium U-bend tubes are examined. Although no attempt has been made to calculate residual stress patterns, a discussion of the formation of residual stresses is presented.

30574 (EPRI-WS—80-136, pp 10.1-10.20) **Accuracy of x-ray diffraction residual stress measurement.** Prevey, P.S. (Lambda Research, Inc., Cincinnati, OH). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

Major sources of experimental error in x-ray diffraction residual stress measurement, both random and systematic, are discussed and a calibration procedure described. Sample dependent error sources due to penetration of the radiation into the subsurface stress gradient and stress relaxation during dissection are discussed. Examples of the variability of surface stresses produced by machining and grinding metallic samples are shown, and their impact upon surface residual stress measurement is considered.

30575 (EPRI-WS—80-136, pp 11.1-11.16) **Residual stress measurements of U-bends and correlation with accelerated stress corrosion tests.** Begley, R.T.; Klein, A.W. (Westinghouse Electric Corp., Pittsburgh, PA). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

Various experimental techniques have been used to determine the residual stresses in U-bends of steam generator tubing. These include x-ray diffraction, strain gage sectioning, and strain

gage sectioning with layer removal. The relative merits of each are discussed and the results from several investigations are presented. There is a large variability, even for a given technique, but most residual stress values are compressive or low tension implying little concern for stress corrosion cracking due to fabrication.

30576 (EPRI-WS—80-136, pp 12.1-12.19) **Surface residual stress distributions in as-bent Inconel 600 U-bend and Incoloy 800 90-degree bend tubing samples.** Prevey, P.S. (Lambda Research, Inc., Cincinnati, OH). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

Selected data showing typical macroscopic residual stress distributions in U-bent Inconel 600 and 90 degrees bends in Incoloy 800 are presented. The results indicate regions of both high magnitude tension and compression in the longitudinal direction around the circumference of the bends at the apex. The microscopic residual stress, or percent plastic strain and macroscopic residual distributions in the surface of cross-roll straightened and ground Inconel 600 tubing are described. The results indicate a compressive surface layer accompanied by a yield strength gradient from 90 ksi at the surface to 30 ksi at a depth of 0.003 in.

30577 (EPRI-WS—80-136, pp 13.1-13.31) **Factors affecting U-bend cracking.** Dobbeni, D.P.; Stubbe-Leroy, J.R.; van Melsen, C.E. (Laborelec, Rhode-St. Genese, Belgium). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

Stress corrosion cracking of alloy 600 in pure water is assumed to be the damaging process of a large number of small radius U-bends of PWR steam generators. The possible influencing parameters are reviewed. The determining factor is a too high level of stress arising from two main origins: residual stresses; and overstresses induced by the inner pressure in deformed cross sections. The latter have been assessed by two dimensional finite elements computation and by strain gages measurements. Stress corrosion tests in boiling $MgCl_2$ sustain the previous results for outer surface overstresses. Geometrical characterizations were performed on: in service SG tubes by internal spherical gages; and laboratory samples by internal spherical gages, LVDT and ultrasonic measurements, cross sectioning.

30578 (EPRI-WS—80-136, pp 14.1-14.9) **Evaluation of residual tensile stresses by accelerated stress corrosion cracking tests.** Berge, J.P. (Electricite de France, Paris). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

Accelerated stress corrosion tests have been shown to be very useful to evaluate the tensile residual stresses. These methods can be applied in many cases where more sophisticated methods, such as strain gauges or x-ray diffraction either are impossible to use because of the shape of the product to be tested, or very expensive and time consuming.

30579 (EPRI-WS—80-136, pp 15.1-15.27) **Stress corrosion cracking tests of Alloy 600.** Theus, G.J. . (Babcock & Wilcox Co., Alliance, OH). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

This report briefly reviews part of the past and current Babcock & Wilcox-sponsored autoclave tests on stress corrosion cracking of Inconel Alloy 600. Results from conventional high-temperature (288° to 360°C) autoclave tests as well as electrochemical, high-temperature (288°C) caustic tests are presented. In some cases, data addressing a particular concern from both conventional and electrochemical tests are available.

30580 (EPRI-WS—80-136, pp 16.1-16.15) **Influence of chemical composition and metallurgical microstructure on stress corrosion cracking (SCC) of Inconel Alloy 600.** Airey, G.P. (Westinghouse Electric Corp., Pittsburgh, PA). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

The occurrence of U-bend cracks can probably be attributed to stress corrosion cracking (SCC) in a primary water environment. Since SCC in caustic and pure water environments has been exclusively intergranular in nature, grain boundary microstructure has been correlated with SCC performance. SCC resistance in Inconel 600 has recently been improved by a thermal treatment in the carbide precipitation regime and the improvement in the SCC resistance correlated with grain boundary microstructure. Microstructural changes that can occur as a result of such a thermal treatment include grain boundary chromium carbide precipitation, an associated chromium depleted layer, and grain boundary segregation. Inconel 600 steam generator tubing, thermally treated over a range of times and temperatures was evaluated for grain boundary microstructure and caustic SCC resistance.

30581 (EPRI-WS—80-136, pp 17.1-17.16) **Stress corrosion failures in Alloy 600 immersion heaters.** Owens, C.M. (Combustion Engineering, Inc., Windsor, CT). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

In the spring of 1979, C-E started up a 350KW model boiler unit at the Chattanooga test facility using heaters rated at 50KW which is about four times the power of previous designs. The watt density of these units was 188 watts/in^2 which is more than double that of the earlier design. The sheath material was Alloy 600 in both the earlier and current units. Within three days from model start-up, the first heater failure was experienced. Over the next three months, nine heaters had experienced sheath cracking and the maximum exposure time for any failed heater was 21 days. Eight of the heaters were found to have through wall cracks and one heater had an O.D. initiated crack 30% through the wall.

30582 (EPRI-WS—80-136, pp 18.1-18.13) **Combustion engineering: steam generator tube bending practices.** Sodergren, J.H. (Combustion Engineering, Inc., Chattanooga, TN). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

The tube bending practices and procedures employed by Combustion Engineering (CE), when bending inconel tubing is discussed. CE has two different type tube geometries in the steam generator. The innermost tubes are 180° U-bends while the majority of the tubes have two (2) 90° bends with a straight leg between these 90° bends. The first 18 rows have U-bends (2 1/2" to 11"R), while the remaining tubes have the double 90° geometry. All double 90° bends are bent to a 10" radius. This presentation will address the following important parameters necessary to achieve a high quality bent tube: fabrication requirements at the tube mill; tube bending equipment; tube bending operation; inspection and final preparation; and packaging.

30583 (EPRI-WS—80-136, pp 20.1-20.13) **Questions on U-bend cracking.** Berge, J.P. (Electricite de France, Paris). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

From the Trojan tube examination, the cracking has been identified as intergranular stress corrosion cracking, starting from the I.D., primary side. Cracking of Alloy 600 tubes has been observed in other locations (tubesheet, tube-support plate in case of denting). Despite the fact that pure water type of stress corrosion cracking has been observed 20 years ago, many unknowns remain on the mechanism of the phenomenon and the evaluation of the risks of further evolution in steam generators.

30584 (EPRI-WS—80-136, pp 21.1-21.14) **Potential corrective measures and additional work required.** Lang, J.F. (Electric Power Research Inst., Palo Alto, CA). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

Coriou cracking is a slow process under typical PWR service conditions. For example, it appears to have taken years for leaks to develop in U-bends of Trojan steam generator tubes. Conse-

quently, temperature, stress, and test chemistry have all been used in various combinations by various investigators to accelerate cracking in the laboratory. The quantitative impact of each parameter is difficult to sort out; however, the qualitative impact is discussed for guidance in identifying potential corrective measures.

30585 **(EPRI-WS—80-157) Workshop proceedings: corrosion of Inconel 600 steam generator tubing in the tubsheet crevice.** Hultman, C.V.; Lucas, R.G.; Paine, J.P.N. (Electric Power Research Inst., Palo Alto, CA (USA)). May 1981. 362p. (CONF-8009163—). NTIS, PC A16/MF A01. Order Number DE81903554.

From Workshop on corrosion of inconel 600 steam generator tubing in the tubesheet crevice; Palo Alto, CA, USA (9 Sep 1980).

The proceedings of a workshop on the problem of the cracking and intergranular attack of Inconel 600 tubing in tubesheet crevices in nuclear reactor steam generators is presented. The objectives of the workshop were to: (1) focus on the problem; (2) identify and prioritize possible mechanisms; (3) focus on the testing necessary to analyze and describe the problem; (4) determine what remedial actions should be taken in the plants; (5) determine what else can be observed from plant data; and (6) provide some assurance that we will be trying to treat the problem and not a symptom of the problem. A summary of the meeting is presented along with each participant's presented material.

30586 (EPRI-WS—80-157, pp A16.1-A16.24) **Field experiences of tube sheet crevice cleaning.** Yashima, S.; Ikenaga, K.; Abe, K.; Hori, K. May 1981. NTIS, PC A16/MF A01.

From Workshop on corrosion of inconel 600 steam generator tubing in the tubesheet crevice; Palo Alto, CA, USA (9 Sep 1980).

In Japan, the tube sheet crevice cleaning by using the pressurizing and depressurizing cyclic cleaning method had been carried out on MIHAMA unit 2 and TAKAHAMA unit 1, which had experienced the phosphate treatment for S.G. secondary chemistry. The effectiveness was recognized by following results: the caustic soda to be flushed out from tube sheet crevice area being identified; and tube degradations at the tube sheet crevice area decreasing.

30587 (EPRI-WS—80-157, pp A17.1-A17.17) **Crevice flushing procedures and experience: Point Beach Nuclear Plant, Units 1 and 2.** Frieling, G.D. (Wisconsin Electric Power Co., Milwaukee). May 1981. NTIS, PC A16/MF A01.

From Workshop on corrosion of inconel 600 steam generator tubing in the tubesheet crevice; Palo Alto, CA, USA (9 Sep 1980).

In August 1979, large numbers of crevice defects were detected during a shutdown of Unit 1 and subsequent eddy current inspection. During a refueling shutdown in October to November 1979, additional defects were detected and sample tubes were pulled from the hot leg side for analysis. The analyses indicated general intergranular attack of the tube material to within 1/2 inch of the top of the tubesheet. Analysis of tube deposits indicated highly alkaline conditions within the tubesheet crevice. In an attempt to minimize further progression of the crevice attack, a crevice flushing procedure was developed by Wisconsin Electric for use at Point Beach. This procedure involves the creation of steam bubbles in the crevice at low temperatures to remove soluble material from the crevices.

30588 **(WCAP—9838) Surry Unit 2 end of cycle 4 onsite fuel examination of 17 x 17 demonstration assemblies after three cycles of exposure.** Balfour, M.G.; Schmidt, G.R.; Muenks, M.F.; Isaac, P.G.; Eng, G.H. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Energy Systems Div.). Feb 1981. Contract AC02-79ET34014. 82p. NTIS, PC A05/MF A01. Order Number DE81028254.

This report presents an evaluation of the results obtained from various onsite nondestructive examinations performed during August 1979, on Surry Unit 2 fuel. The fuel consisted of 17 x 17 demonstration fuel assemblies placed in the Surry Unit 2 reactor for reactor cycles 2, 3, and 4, along with 15 x 15 fuel assemblies in the remainder of the core. Two three-cycle 17 x 17 demonstration fuel assemblies, four two-cycle 17 x 17 removable fuel rods, and eight three-cycle 17 x 17 removable fuel rods were examined. The nondestructive examinations included television visual examinations and grid cell friction force measurments performed on the demonstration assemblies and breakaway/withdrawal force measurements, television visual examinations, and profilometry measurements performed on the removable fuel rods. Summaries of the design features of the 17 x 17 demonstration assemblies, the characterization program conducted during fabrication, and previous onsite nondestructive examinations performed on them are contained within the report. A brief description of the irradiation history of the 17 x 17 demonstration assemblies and removable rods is also presented.

30589 **Steam generator nozzle dams for primary head activities.** Lewis, J.T.; Woods, J.L. (Combust Eng Inc, Chattanooga, Tenn). *American Society of Mechanical Engineers, [Paper]* ; No. 80-C2/NE-11, 1-5(Aug 1980).

During routine plant outages for reactor vessel refueling, certain essential activities must be performed within steam generator primary heads to permit continued operation of the nuclear system. The most frequently performed activity is the eddy current testing of the heat transfer tubing. Typical activities require both personnel and equipment access into the primary head of a steam generator. To permit such access, devices are required which can isolate the primary head from the reactor coolant that keeps the fuel bundle covered. This paper presents the basic design of one such device and identifies some of the initial design considerations which led to the design of the light weight structures that require a minimum of man-rem exposure for installation. The main features of the dam design are also described.

30590 **Steam 80 steam generator instrumentation.** Carson, W.H.; Harris, H.H. (Combust Eng Inc, Chattanooga, Tenn). *American Society of Mechanical Engineers, [Paper]* ; No. 80-C2/NE-12, 1-4(Aug 1980).

This paper describes two special instrumentation packages in an integral economizer (preheater) steam generator of one of the first System 80 plants scheduled to go into commercial operation. The purpose of the instrumentation is to obtain accurate operating information from regions of the secondary side of the steam generator inaccessible to normal plant instrumentation. In addition to verification of the System 80 steam generator design predictions, the data obtained will assist in verification of steam generator thermal/hydraulic computer codes developed for generic use in the industry.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 30619, 30620, 30629, 30640

30591 **(DOE/ET/35300—T2) HTGR generic technology program plan (FY 80).** (General Atomic Co., San Diego, CA (USA)). Jan 1980. Contract AT03-76ET35300. 66p. NTIS, PC A04/MF A01.

Purpose of the program is to develop base technology and to perform design and development common to the HTGR Steam Cycle, Gas Turbine, and Process Heat Plants. The generic technology program breaks into the base technology, generic component, pebble-bed study, technology transfer, and fresh fuel programs. (DLC)

30592 **(GA-A—16258) Postirradiation examination and evaluation of Fort St. Vrain fuel element 1-0743.** Saurwein, J.J.; Miller, C.M.; Young, C.A. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AT03-76ET35301. 150p. NTIS, PC A07/MF A01. Order Number DE81028505.

Fort St. Vrain (FSV) fuel element 1-0743 was irradiated in core location 17.04.F.06 from July 3, 1976 until February 1, 1979. The element experienced an average fast neutron exposure of about 0.95×10^{25} n/m^2 (E > 29 fJ)/sub HTGR/, a time-and-volume-averaged fuel temperature in the vicinity of 680°C, fissile and fertile particle burnups of approximately 6.2% and 0.3%, respectively, and

a total burnup of 12,210 MWd/tonne. The postirradiation examination revealed that the element was in excellent condition. No cracks were observed on any of the element surfaces. The structural integrity of the fuel rods was good. No evidence of mechanical interaction between the fuel rods and fuel body was observed. Calculated irradiation parameters obtained with HTGR design codes were compared with measured data. Radial and axial power distributions, irradiation temperatures, neutron fluences, and fuel burnups were in good agreement with measurements. Calculated fuel rod strains were about a factor of three greater than were observed.

30593 **(ORNL—5753) High-temperature gas-cooled reactor technology development program. Annual progress report for period ending December 31, 1980.** (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 332p. NTIS, PC A15/MF A01. Order Number DE81029096.

Research activities are described concerning HTGR chemistry; fueled graphite development; prestressed concrete pressure vessel development; structural materials; HTGR graphite studies; HTR core evaluation; reactor physics; shielding; application and project assessments; and HTR Core Flow Test Loop studies.

30594 **HTGR-GT systems optimization studies.** Kammerzell, L.L.; Read, J.W. (Gen At Co, San Diego, Calif). *American Society of Mechanical Engineers, [Paper] ;* No. 80-WA/GT-3, 1-8(Nov 1980).

The compatibility of the inherent features of the high-temperature gas-cooled reactor (HTGR) and the closed-cycle gas turbine combined into a power conversion system results in a plant with characteristics consistent with projected utility needs and national energy goals. These characteristics are (1) plant siting flexibility; (2) high resource utilization; (3) low safety risks; (4)) proliferation resistance; and (5) low occupational exposure for operating and maintenance personnel. 9 refs.

30595 **Improvement of high temperature heat exchanger efficiency by inserted porous metal plates.** Fukuda, K.; Hasegawa, S.; Echigo, R.; Akinaga, M. (Kyushu Univ, Fukuoka, Jpn). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-59, 1-6(Jul 1980).

Augmentation of high temperature shell-and-tube heat exchanger efficiency by insertions of porous plates is experimentally investigated. The results show its advantageous feature that the Nusselt number increases by 40 to 65 percent and that the shell temperature could be purposely cooled to meet the requirements from structural designing. 5 refs.

30596 **Heat exchanger design considerations for high-temperature gas-cooled reactor (HTGR) plants.** McDonald, C.F.; Vrable, D.L.; van Hagan, T.H.; King, J.H.; Spring, A.H. (Gen At Co, San Diego, Calif). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-62, 1-13(Jul 1980).

This paper discusses various aspects of the high-temperature heat exchanger conceptual designs for the gas turbine (HTGR-GT) and process heat (HTGR-PH) plants. Topics include technology background, heat exchanger types, surface geometry, thermal sizing, performance, material selection, mechanical design, fabrication, and the systems-related impact of installation and integration of the units in the prestressed concrete reactor vessel. The impact of future technology developments, such as the utilization of nonmetallic materials and advanced heat exchanger surface geometries and methods of construction, is also discussed. 23 refs.

30597 **Performances of heat exchangers on HTGR application.** Mori, Y. (Tokyo Inst of Technol, Jpn). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-39, 1-15(Jul 1980).

Rising oil price is making the high-temperature gas-cooled reactor (HTGR) an attractive alternative energy resource for high temperature process heat applications. Motivation and aspect of nuclear process applications to steam reforming and coal gasification, etc. are described. Studies on heat transfer problems are reviewed. The present status of designed high temperature heat exchangers is summarized. The performances of He-He high temperature heat exchanger tested in Japan is reported. Several problems in the future research and development of technologies for process heat application by HTGR are discussed. 29 refs.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 30626, 30627, 30628, 30636, 30637, 30638, 30641, 30644, 30648, 30649, 30924

30598 **(CONF-810801—52) Test of small-scale central-core-cavity closure for a 300-MW(e) GCFR.** Robinson, G.C.; Dougan, J.R.; Naus, D.J. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01. Order Number DE81028880.

From 6. international conference on structural mechanics in reactor technology; Paris, France (17 Aug 1981).

Portions of this document are illegible.

Under the Prestressed Concrete Reactor Vessel (PCRV) Program at the Oak Ridge National Laboratory, model tests are conducted to verify the design of the PCRV for a 300 MW(e) Gas-Cooled Fast Reactor (GCFR). Prominent features of the 1:20-scale central core cavity model included a close pitched array of fifty-five penetration tubes, forty-four segmented gusset/bearing plate assemblies, and intermeshed reinforcing steel. The closure model which was designed for a maximum cavity pressure (MCP) of 10.08 MPa was initially tested by applying 10 pressurization cycles from essentially no load to the MCP with strain and deflection data obtained during each cycle. This was followed by pressurization cycles to 32.8 MPa, 41.3 MPa, 48.3 MPa, 58.4 MPa and 79.3 MPa. At a pressure of 79.3 MPa an end cap on a penetration tube developed leaks and the test was terminated. An inelastic analysis was conducted to provide an estimate of the ultimate strength of the closure plug and to determine the potential mode of failure.

30599 **(DOE/SF/00824—T13) Mathematical probability method for predicting fuel-pin reliability.** O'Reilly, B.D. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1973. Contract AM03-76SF00824. 33p. NTIS, PC A03/MF A01. Order Number DE81025758.

This report re-introduces and amplifies the margin analysis method for predicting fuel-pin reliability. It is applicable to any fuel-pin performance model whose state variables (stresses, strains, temperature, etc.) obey a system of field equations, some of which are first-order rate equations and some of which constitute a subsystem of instantaneous constraints. For illustrative purposes it has been adapted for application to GE's PECS-II gas-pressure performance model.

30600 **(DOE/SF/00824—T14) Hydraulically supported absorber balls ISS (inherent shutdown system) - water loop testing, absorber column.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Nov 1976. Contract AM03-76SF00824. 7p. NTIS, PC A02/MF A01. Order Number DE81026448.

Design and analysis effort is required to initiate development of the Hydraulically Supported Absorber Ball ISS for advanced LMFBR's. Therefore, parametric evaluations are necessary through testing in a realistic hydraulic environment and physical envelope that has adjustment capability. Earlier tests at AI established the basic feasibility of this concept. Important test determinations include ball column lifting and dropout flow rates/pressures, stack stability, possible jamming in a distorted channel, and absorber ball drop times versus fast flow shutoff and flow coastdown rate simulation. The data from these tests will make it possible to understand the behavior of this system and to design a reliable ISS for advanced LMFBR's.

30601 **(DOE/SF/00824—T19) Irradiation effects. Task 2. Irradiation damage in cladding and core structural materials.** Garr, K.R.; Keefer, D.W.; Kramer, D.; Nakata, M.M.; Pard, A.G. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 1974. Contract AM03-76SF00824. 22p. NTIS, PC A02/MF A01. Order Number DE81026150.

Information is presented concerning the radiation effects on swelling of stainless steel-316 and stainless steel-405.

30602 **(DOE/SF/91001—T4) Sodium technology: Task 1, sodium removal and decontamination of components.** Welch, F.H.; Steele, O.P. III. (Rockwell International Corp., Canoga Park, CA (USA)). 1975. Contract AT03-76SF91001. 135p. NTIS, PC A07/MF A01. Order Number DE81026452.

Objectives are to develop and test methods for removing sodium from specimens and components by evaporative and local heat gun techniques and by reacting with alcohol. (DLC)

30603 **(DOE/SF/98001—T7) Standpipe-Bubbler level-control study, W.P. 7373. Engineering memorandum EM 0225. Final report.** (General Electric Co., Sunnyvale, CA (USA)). 1977. Contract AT03-76SF98001. 264p. NTIS, PC A12/MF A01.

Portions of document are illegible.

This report contains the results of the study effort to determine the effectiveness of a Standpipe Bubbler liquid level controller for the Clinch River Breeder Reactor Primary Pumps.

30604 **(DOE/SF/98001—T8) Standpipe-Bubbler pump level control study: 1E-3862, controlled clearance pump/system model analysis (Task A) W.P. 7373. Engineering memorandum 0190.** Salant, R.F.; Cook, M.E. (General Electric Co., Sunnyvale, CA (USA); Borg-Warner Corp., Los Angeles, CA (USA). Byron Jackson Pump Div.). 7 Jun 1976. Contract AT03-76SF98001. 99p. NTIS, PC A05/MF A01. Order Number DE81023600.

Computer simulation results of the Standpipe-Bubbler pump level control system/controlled clearance pump configuration 1E-3862 are presented. Fluid level control system behavior is presented in graphical form for normal plant loading, unloading, and trip transients, under varying conditions of cover gas mass flow rate, tank impedances, temperature, and flow rates through discharge seal and bearing leakage paths. Satisfactory fluid level control can be attained for this configuration with a Standpipe-Bubbler system.

30605 **(EPRI-NP—1887) Locating failed fuel in LMFBRs: selection of candidate solid tags. Final report.** Lee, J.S.; McCarthy, W.H. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Jun 1981. 73p. NTIS, PC A04/MF A01. Order Number DE81903810.

The selection of six candidate elements for use as nuclear reactor cladding-breach monitors is described. Solid tags are considered potentially more satisfactory than gas-phase tags in an LMFBR application because solid tags should indicate breach only when fuel/sodium contact occurs. The six candidate elements have a minimum of five usable nuclides each; and in approximate order of merit they are: Pb, Sn, Ti, Zn, Ge and Cd. This report describes the data used, their sources, and the compilation methods. A computer program, written to compare systematically the element and nuclide properties against input criteria to be supplied by the user, is also described. Plans for emperical demonstrations of the method were outlined.

30606 **(HEDL-UOR—79-040) Inoperable HTS pressure sensor due to NaK leak. Final unusual occurrence report.** Beagles, D.B. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Contract AC14-76FF02170. 8p. (HEDL—79-40-FFTF-64). NTIS, PC A02/MF A01. Order Number DE81027542.

The report describes an inoperable pressure sensor in the primary heat transport system, due to a NaK leak between the transducer and bellows seal assembly. The pressure transducer capillary tube and seal assembly was replaced during a planned Heat Transport System test that required reduced sodium level, resulting in no schedule impact.

30607 **(HEDL-UOR—80-003) Damage to an FFTF chiller unit. Final unusual occurrence report.** Rhoads, D.A. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Contract AC14-76FF02170. 8p. (HEDL—80-3-FFTF-77). NTIS, PC A02/MF A01. Order Number DE81027548.

The report describes damage to an FFTF Chiller Unit due to running the unit without proper lubrication. A detailed assessment of this occurrence was conducted by personnel assigned from the FFTF Project Office. The results of that assessment, transmitted in the referenced letter, are included and addressed as part of the report.

30608 **(HEDL-UOR—80-006) Unplanned loss of the FFTF inert gas cooling system for the control rod drive mechanisms. Final unusual occurrence report.** Kuechle, J.D. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Contract AC14-76FF02170. 4p. (HEDL—80-6). NTIS, PC A02/MF A01. Order Number DE81027569.

The report describes the unplanned loss of the FFTF inert gas cooling resulting in a manual scram of the reactor. This event caused about eight hours delay in low power physics testing. No hazard to the health and safety of the public was presented.

30609 **(NEDM—14063) Small-leak behavior: summary report on scoping tests.** Sandusky, D.W. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Jun 1975. Contract AT03-76SF70010. 45p. NTIS, PC A03/MF A01. Order Number DE81026539.

A scoping phase has been completed on a study of small steam leaks in Liquid Metal Fast Breeder Reactor steam generators. Methods were developed to fabricate leaks in the size range of 10^{-10} to 10^{-5} lb/sec H_2O in 2 1/4 Cr-1 Mo steam generator tubing of prototypic wall thickness (~ 0.110 inch). A test system was modified to supply flowing superheated steam at 1525 psig to as many as three specimens immersed in flowing sodium. Test results are presented.

30610 **(ORNL/Sub—81-92304/1) Assessment of the computer code COBRA/CFTL.** Baxi, C.B.; Burhop, C.J. (Oak Ridge National Lab., TN (USA); General Atomic Co., San Diego, CA (USA)). Jul 1981. Contract W-7405-ENG-26. 238p. (GA-A—16359). NTIS, PC A11/MF A01. Order Number DE81027933.

The COBRA/CFTL code has been developed by Oak Ridge National Laboratory (ORNL) for thermal-hydraulic analysis of simulated gas-cooled fast breeder reactor (GCFR) core assemblies to be tested in the core flow test loop (CFTL). The COBRA/CFTL code was obtained by modifying the General Atomic code COBRA*GCFR. This report discusses these modifications, compares the two code results for three cases which represent conditions from fully rough turbulent flow to laminar flow. Case 1 represented fully rough turbulent flow in the bundle. Cases 2 and 3 represented laminar and transition flow regimes. The required input for the COBRA/CFTL code, a sample problem input/output and the code listing are included in the Appendices.

30611 **LMFBR conceptual design study balance of plant design.** Ehrman, C.S.; Golan, S.; Garabedian, G. (Burns and Roe Inc, Oradell, NJ). *American Society of Mechanical Engineers, [Paper] ;* No. 80-C2/NE-3, 1-5(Aug 1980).

The LMFBR conceptual design study balance of plant design for the CDS Phase II commenced December 1, 1979. The objectives of this effort are to develop building general arrangement drawings showing the location of major equipment and systems, write brief system design descriptions, compile cost estimates, and prepare overall engineering, procurement, and construction schedules. Work described in this paper represents the status of the design as of February 1, 1980.

30612 **LMFBR operational and experimental local-fault experience, primarily with oxide fuel elements.** Warinner, D.K. (Argonne Natl Lab, Ill). *American Society of Mechanical Engineers, [Paper] ;* No. 80-C2/NE-21, 1-9(Aug 1980).

Case-by-case reviews of selective world experience with severe local faults, particularly fuel failure and fuel degradation, are

reviewed for two sodium-cooled thermal reactors, several LMFBRs, and LMFBR-fuels experiments. The review summarizes fuel-failure frequency and illustrates the results of the most damaging LMFBR local-fault experiences of the last 20 years. Local-fault accommodation is demonstrated and a need to more thoroughly investigate delayed-neutron and gaseous-fission-product signals is highlighted in view of uranate formation, observed blockages, and slow fuel-element failure-propagation. 32 refs.

30613 **Pellet-cladding interaction of LMFBR fuel elements at unsteady state.** Ma, B.M. (Iowa State Univ, Ames). *American Society of Mechanical Engineers, [Paper] ;* No. 80-C2/NE-26, 1-13(Aug 1980).

The fuel pellet-cladding interaction of liquid-metal fast breeder reactor fuel elements or fuel rods at unsteady state is analyzed and discussed based on experimental results. In the analyses, the heat generation, fuel restructuring, temperature distribution, gap conductance, irradiation swelling, irradiation creep, fuel burnup, fission gas release, fuel pellet cracking, crack healing, cladding cracking, yield failure and fracture failure of the fuel elements are taken into consideration. 10 refs.

30614 **Design and development of a once-through helical coil steam generator for large LMFBR plants.** Grant, G. (Babcock and Wilcox Co, Barberton, Ohio). *American Society of Mechanical Engineers, [Paper] ;* No. 80-C2/NE-29, 1-7(Aug 1980).

The paper outlines the design and development program to produce a highly reliable, once-through, helical coil tube steam generator for future large liquid metal fast breeder reactor (LMFBR) plants. The detailed design features of the plant and prototype units are described, and a brief description is given of the supporting RandD program. 5 refs.

30615 **(DOE/SF/00824—T15) Cover gas seals.** Kurzeka, W.; Oliva, R.; Shimazaki, T. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). [nd]. Contract AM03-76SF00824. 65p. NTIS, PC A04/MF A01. Order Number DE81026846.

Testing in support of the FFTF program has been completed except for 11 compression set tests to be concluded in January 1975. Two types of seal tests were run in the program: demonstration tests and information tests. The demonstration tests evaluated the performance of various seal types when tested under conditions representative of those specified for FFTF seal design conditions. Demonstration tests were about 6 months in duration for each group of test seals. Information tests measured the short-term performance of various seal types under broader ranges of seal variable conditions, to determine appropriate new guidelines and/or seal standards for use in the design of current or future reactor systems. The CRBRP inflatable seals and the turntable assembly were removed as a fully assembled unit from the seal drive system and set up for a long-term, elevated temperature, storage test.

30616 **(DOE/SF/74016—T3) Asymmetric stress and failure analysis.** Yu, J.; Westmann, R. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). [nd]. Contract AT03-76SF74016. 6p. NTIS, PC A02/MF A01. Order Number DE81026842.

The purpose of this study is to consider the cladding failure due to asymmetric structural response of the fuel cell. In general, the fuel cracks early in use before appreciable swelling may occur. Such cracks might heal due to resintering but the fuel swelling actually leads to partial or even total contact between the fuel and cladding. Continued swelling and restructuring can then result in cladding failure. Examination of this process is divided into two phases. The first phase is concerned with the fracture and cracking patterns prior to the development of fuel-cladding contact. The second phase is to deal with the forces in the cladding after fuel-cladding contact has been made.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

30617 **(LA-UR—81-1626) Space nuclear reactors: energy gateway into the next millennium.** Angelo, J.A. Jr.; Buden, D. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 22p. (CONF-810915—1). NTIS, PC A02/MF A01.

From 32. international astronautical congress; Rome, Italy (6 Sep 1981).

Power - reliable, abundant and economic - is the key to man's conquest of the Solar System. Space activities of the next few decades will be highlighted by the creation of the extraterrestrial phase of human civilization. Nuclear power is needed both to propel massive quantities of materials through cislunar and eventually translunar space, and to power the sophisticated satellites, space platforms, and space stations of tomorrow. To meet these anticipated future space power needs, the Los Alamos National Laboratory is developing components for a compact, 100-kW(e) heat pipe nuclear reactor. The objectives of this program are to develop components for a space nuclear power plant capable of unattended operation for 7 to 10 years; having a reliability of greater than 0.95; and weighing less than 1910 kg. In addition, this heat pipe reactor is also compatible for launch by the US Space Transportation System.

2107 Regulation And Licensing

30618 **(EPRI-WS—80-136, pp 2.1-2.16) NRC concerns about steam generator tube U-bend failures.** Dillon, R.L. (Battelle Memorial Inst., Richland, WA). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

This paper concerns itself with genralized NRC regulatory policy regarding SGT failures and staff reports and opinions which may tend to influence the developing policy specific to U-bend failures. The most significant analysis at hand in predicting NRC policy on SGT U-bend failures is Marsh's Evaluation of Steam Generator Tube Rupture Events. Marsh sets out to describe and analyze the five steam generator tube ruptures that are known to NRC. All have occurred in the period 1975 to 1980.

2108 Economics

REFER ALSO TO CITATION(S) 30693

2109 Process Heat Reactors

REFER ALSO TO CITATION(S) 30591, 30597

30619 **(CONF-810812—33) High-temperature gas-cooled-reactor applications to fossil-conversion processes.** Kasten, P.R.; Gambill, W.R. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE81028607.

From IECEC conference; Atlanta, GA, USA (9 Aug 1981).

High-Temperature Gas-Cooled Reactors (HTRs) permit nuclear energy to be applied to a number of fossil-fuel conversion processes. In general, these processes require application of a steam-methane reformer; for such applications, an HTR with an outlet coolant temperature in the range of 850 to 950°C is required. Such systems are applicable to chemicals production, a number of fossil conversion processes, as well as to chemical heat pipes. A relatively early application of reformer HTRs might be the steam reforming of methane to produce synthesis gas for chemicals production. At the same time, one of the coal conversion processes examined has energy requirements such that a steam-cycle HTR having an outlet coolant temperature of 750°C will provide about 90% of the total primary energy requirements. In general, screening studies of coal and oil shale conversion processes indicate that coupling HTR technology with fossil conversion technologies can lead to significantly reduced fossil fuel consumption and reduced pollutant generation.

30620 **(DOE/TIC—1028102) Comparison of the cladding deformation measured during the Power Burst Facility loss-of-coolant accident in-pile experiments with recent Oak Ridge National Laboratory out-of-pile results.** Broughton, J.M.; McCardell, R.K.; MacDonald, P.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 18p. NTIS, PC A02/MF A01. Order Number DE81028102.

A series of four large break loss-of-coolant accident fuel behavior experiments have been performed in the Power Burst Facility. The results of these experiments are briefly reviewed and compared with results from the ORNL multirod burst test program. The effect of cladding burst temperature and prior irradiation were investigated. The cladding strain of the previously irradiated test rods was more uniformly distributed around the cladding circumference and larger than for similar unirradiated test rods. The ORNL out-of-pile single rod test results are in good agreement with the Power Burst Facility (PBF) test results with unirradiated test rods, and the ORNL out-of-pile, single-rod test results with heated shrouds and the PBF test results with previously irradiated test rods are comparable.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

30621 **(LA—8910-PR) Transport and reactor therory. Progress report, January 1 - March 31, 1981.** Dudziak, D.J.; O'Dell, R.D.; Alcouffe. R.E. (Los Alamos Scientific Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 63p. NTIS, PC A04/MF A01. Order Number DE81028596.

Research and development progress in transport and reactor therory by the Los Alamos National Laboratory's Group T-1 for the second quarter of FY 81 is reported. Included are tasks in the areas of Fission Reactor Neutronics, Transport Methods Supporting Research, Reactor Safety Analysis, Fusion Reactor Nucleonics, and Special Projects.

2202 Components And Accessories

30622 **(DOE/ET/13511—T7) Development of automated welding process for field fabrication of thick-walled pressure vessels.** Schneider, U.A. (Westinghouse Electric Corp., Tampa, FL (USA). Nuclear Equipment Div.). 1981. Contract AC05-78ET13511. 14p. NTIS, PC A02/MF A01. Order Number DE81025454.

The following tasks are reported on: review of welding processes, adaptation of the GTAW-HW narrow-groove process to vertical and horizontal welds, 8-inch thick field demonstration/qualification welds, and welding procedure handbook. Procedure qualification records [TQ 339] are given for the gas tungsten arc-hot wire welding of 2 1/4 Cr - 1 Mo steel. (DLC)

30623 **Double summation procedure for the combination of seismic responses of multiply-excited piping systems.** Sundararajan, C. (EDS Nucl Inc, San Francisco, Calif). *American Society of Mechanical Engineers, [Paper] ;* No. 80-WA/PVP-1, 1-4(Nov 1980).

The multiple response spectrum method of seismic analysis is becoming popular to analyze piping systems subjected to different excitations at different supports or support groups. In this method the maximum responses due to each excitation in each mode of vibration are calculated separately by the response spectrum method, and then the responses due to each excitation are combined suitably to obtain the total modal responses. In this paper a more rational double summation procedure is derived, and the theoretical basis and approximations involved are discussed. 10 refs.

30624 **Plastic fracture mechanics prediction of fracture instability in a circumferentially cracked pipe in bending--2. Experimental verification on a Type 304 stainless steel pipe.** Wilkowski, G.M.; Zahoor, A.; Kanninen, M.F. (Battelle, Columbus Lab, Ohio). *American Society of Mechanical Engineers, [Paper] ;* No. 80-WA/PVP-4, 1-10(Nov 1980).

The possibility of a pipe fracture emanating from a stress corrosion crack in the heat-affected zones of girth-welds in Type 304 stainless steel pipes was investigated. The J-resistance curve--tearing modulus parameter for the prediction of crack initiation, stable growth and fracture instability--was employed. In the actual experiment, the onset of fracture instability occurred beyond maximum load at an average stable crack growth of 16 to 19 mm (0.63 to 0.75-in.) at each tip. 6 refs.

30625 **Annual book of ASTM standards. Part 45. Nuclear standards.** Philadelphia, PA; American Society for Testing and Materials (1980). 1320p. $49.00.

The standards are assembled in each part in alphanumeric sequence of their ASTM designation numbers. Each part has two tables of contents: a list of the standards in alphanumeric sequence of their ASTM designations; and a list of the standards classified according to subject. A subject index of the standards and tentatives in each part appears at the back of each volume. This part contains standards concerning concrete products for nuclear applications; graphite products for nuclear applications; metal products for nuclear applications; nuclear-grade materials; radiation effects in organic materials; radioactivity, inorganic materials in water; analysis, dosimetry, and radiation effects in metals; matrix analysis for energy applications; temperature measurement; and protective coating and lining work for power generation facilities.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 30923

2204 Control Systems

30626 **(DOE/SF/70005—T2) Control assembly development: Task 5-absorber studies, heating experiments, design studies. Annual report.** Specht, E.R.; Springer, T.H.; Otter, J.M.; Anderson, R.V. (Rockwell International Corp., Canoga Park, CA (USA)). 1974. Contract AT03-76SF70005. 37p. NTIS, PC A03/MF A01. Order Number DE81026152.

The overall objectives of the Control Assembly Development Program consist of evaluations and analytical studies of reactor control materials in environments typical of fast reactors, and the testing of various materials, systems, and mockups in order to permit the design of reliable and effective control rods for full-scale LMFBR systems. The program encompasses measurements of heating rates and cooling requirements in control rods having typical geometrical arrangements of absorber pins, studies of the behavior of the absorber material as a result of irradiation in the reactor environment, and the analytical study and design of control rod systems.

30627 **(HEDL-SA—2236-FP) Helium diffusion in irradiated boron carbide.** Hollenberg, G.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1981. Contract AC14-76FF02170. 18p. (CONF-810528—10). NTIS, PC A02/MF A01. Order Number DE81027848.

From 83. symposium on nucleation and crystallization in glasses; Washington, DC, USA (3 May 1981).

Boron carbide has been internationally adopted as the neutron absorber material in the control and safety rods of large fast breeder reactors. Its relatively large neutron capture cross section at high neutron energies provides sufficient reactivity worth with a minimum of core space. In addition, the commercial availability of boron carbide makes it attractive from a fabrication standpoint. Instrumented irradiation experiments in EBR-II have provided continuous helium release data on boron carbide at a variety of operating temperatures. Although some microstructural and compositional variations were examined in these experiments most of the boron carbide was prototypic of that used in the Fast Flux Test Facility. The density of the boron carbide pellets was approximately 92% of theoretical. The boron carbide pellets were approximately 1.0 cm in diameter and possessed average grain sizes that varied from 8 to 30 μm. Pellet centerline temperatures were continually measured during the irradiation experiments.

reviewed for two sodium-cooled thermal reactors, several LMFBRs, and LMFBR-fuels experiments. The review summarizes fuel-failure frequency and illustrates the results of the most damaging LMFBR local-fault experiences of the last 20 years. Local-fault accommodation is demonstrated and a need to more thoroughly investigate delayed-neutron and gaseous-fission-product signals is highlighted in view of uranate formation, observed blockages, and slow fuel-element failure-propagation. 32 refs.

30613 **Pellet-cladding interaction of LMFBR fuel elements at unsteady state.** Ma, B.M. (Iowa State Univ, Ames). *American Society of Mechanical Engineers, [Paper] ;* No. 80-C2/NE-26, 1-13(Aug 1980).

The fuel pellet-cladding interaction of liquid-metal fast breeder reactor fuel elements or fuel rods at unsteady state is analyzed and discussed based on experimental results. In the analyses, the heat generation, fuel restructuring, temperature distribution, gap conductance, irradiation swelling, irradiation creep, fuel burnup, fission gas release, fuel pellet cracking, crack healing, cladding cracking, yield failure and fracture failure of the fuel elements are taken into consideration. 10 refs.

30614 **Design and development of a once-through helical coil steam generator for large LMFBR plants.** Grant, G. (Babcock and Wilcox Co, Barberton, Ohio). *American Society of Mechanical Engineers, [Paper] ;* No. 80-C2/NE-29, 1-7(Aug 1980).

The paper outlines the design and development program to produce a highly reliable, once-through, helical coil tube steam generator for future large liquid metal fast breeder reactor (LMFBR) plants. The detailed design features of the plant and prototype units are described, and a brief description is given of the supporting RandD program. 5 refs.

30615 **(DOE/SF/00824—T15) Cover gas seals.** Kurzeka, W.; Oliva, R.; Shimazaki, T. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). [nd]. Contract AM03-76SF00824. 65p. NTIS, PC A04/MF A01. Order Number DE81026846.

Testing in support of the FFTF program has been completed except for 11 compression set tests to be concluded in January 1975. Two types of seal tests were run in the program: demonstration tests and information tests. The demonstration tests evaluated the performance of various seal types when tested under conditions representative of those specified for FFTF seal design conditions. Demonstration tests were about 6 months in duration for each group of test seals. Information tests measured the short-term performance of various seal types under broader ranges of seal variable conditions, to determine appropriate new guidelines and/or seal standards for use in the design of current or future reactor systems. The CRBRP inflatable seals and the turntable assembly were removed as a fully assembled unit from the seal drive system and set up for a long-term, elevated temperature, storage test.

30616 **(DOE/SF/74016—T3) Asymmetric stress and failure analysis.** Yu, J.; Westmann, R. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). [nd]. Contract AT03-76SF74016. 6p. NTIS, PC A02/MF A01. Order Number DE81026842.

The purpose of this study is to consider the cladding failure due to asymmetric structural response of the fuel cell. In general, the fuel cracks early in use before appreciable swelling may occur. Such cracks might heal due to resintering but the fuel swelling actually leads to partial or even total contact between the fuel and cladding. Continued swelling and restructuring can then result in cladding failure. Examination of this process is divided into two phases. The first phase is concerned with the fracture and cracking patterns prior to the development of fuel-cladding contact. The second phase is to deal with the forces in the cladding after fuel-cladding contact has been made.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

30617 **(LA-UR—81-1626) Space nuclear reactors: energy gateway into the next millennium.** Angelo, J.A. Jr.; Buden, D. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 22p. (CONF-810915—1). NTIS, PC A02/MF A01.

From 32. international astronautical congress; Rome, Italy (6 Sep 1981).

Power - reliable, abundant and economic - is the key to man's conquest of the Solar System. Space activities of the next few decades will be highlighted by the creation of the extraterrestrial phase of human civilization. Nuclear power is needed both to propel massive quantities of materials through cislunar and eventually translunar space, and to power the sophisticated satellites, space platforms, and space stations of tomorrow. To meet these anticipated future space power needs, the Los Alamos National Laboratory is developing components for a compact, 100-kW(e) heat pipe nuclear reactor. The objectives of this program are to develop components for a space nuclear power plant capable of unattended operation for 7 to 10 years; having a reliability of greater than 0.95; and weighing less than 1910 kg. In addition, this heat pipe reactor is also compatible for launch by the US Space Transportation System.

2107 Regulation And Licensing

30618 (EPRI-WS—80-136, pp 2.1-2.16) **NRC concerns about steam generator tube U-bend failures.** Dillon, R.L. (Battelle Memorial Inst., Richland, WA). Jun 1981. NTIS, PC A15/MF A01.

From Workshop on U-bend tube cracking in steam generators; Denver, CO, USA (20 Aug 1980).

This paper concerns itself with genralized NRC regulatory policy regarding SGT failures and staff reports and opinions which may tend to influence the developing policy specific to U-bend failures. The most significant analysis at hand in predicting NRC policy on SGT U-bend failures is Marsh's Evaluation of Steam Generator Tube Rupture Events. Marsh sets out to describe and analyze the five steam generator tube ruptures that are known to NRC. All have occurred in the period 1975 to 1980.

2108 Economics

REFER ALSO TO CITATION(S) 30693

2109 Process Heat Reactors

REFER ALSO TO CITATION(S) 30591, 30597

30619 **(CONF-810812—33) High-temperature gas-cooled-reactor applications to fossil-conversion processes.** Kasten, P.R.; Gambill, W.R. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE81028607.

From IECEC conference; Atlanta, GA, USA (9 Aug 1981).

High-Temperature Gas-Cooled Reactors (HTRs) permit nuclear energy to be applied to a number of fossil-fuel conversion processes. In general, these processes require application of a steam-methane reformer; for such applications, an HTR with an outlet coolant temperature in the range of 850 to 950°C is required. Such systems are applicable to chemicals production, a number of fossil conversion processes, as well as to chemical heat pipes. A relatively early application of reformer HTRs might be the steam reforming of methane to produce synthesis gas for chemicals production. At the same time, one of the coal conversion processes examined has energy requirements such that a steam-cycle HTR having an outlet coolant temperature of 750°C will provide about 90% of the total primary energy requirements. In general, screening studies of coal and oil shale conversion processes indicate that coupling HTR technology with fossil conversion technologies can lead to significantly reduced fossil fuel consumption and reduced pollutant generation.

30620 **(DOE/TIC—1028102) Comparison of the cladding deformation measured during the Power Burst Facility loss-of-coolant accident in-pile experiments with recent Oak Ridge National Laboratory out-of-pile results.** Broughton, J.M.; McCardell, R.K.; MacDonald, P.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 18p. NTIS, PC A02/MF A01. Order Number DE81028102.

A series of four large break loss-of-coolant accident fuel behavior experiments have been performed in the Power Burst Facility. The results of these experiments are briefly reviewed and compared with results from the ORNL multirod burst test program. The effect of cladding burst temperature and prior irradiation were investigated. The cladding strain of the previously irradiated test rods was more uniformly distributed around the cladding circumference and larger than for similar unirradiated test rods. The ORNL out-of-pile single rod test results are in good agreement with the Power Burst Facility (PBF) test results with unirradiated test rods, and the ORNL out-of-pile, single-rod test results with heated shrouds and the PBF test results with previously irradiated test rods are comparable.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

30621 **(LA—8910-PR) Transport and reactor therory. Progress report, January 1 - March 31, 1981.** Dudziak, D.J.; O'Dell, R.D.; Alcouffe. R.E. (Los Alamos Scientific Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 63p. NTIS, PC A04/MF A01. Order Number DE81028596.

Research and development progress in transport and reactor therory by the Los Alamos National Laboratory's Group T-1 for the second quarter of FY 81 is reported. Included are tasks in the areas of Fission Reactor Neutronics, Transport Methods Supporting Research, Reactor Safety Analysis, Fusion Reactor Nucleonics, and Special Projects.

2202 Components And Accessories

30622 **(DOE/ET/13511—T7) Development of automated welding process for field fabrication of thick-walled pressure vessels.** Schneider, U.A. (Westinghouse Electric Corp., Tampa, FL (USA). Nuclear Equipment Div.). 1981. Contract AC05-78ET13511. 14p. NTIS, PC A02/MF A01. Order Number DE81025454.

The following tasks are reported on: review of welding processes, adaptation of the GTAW-HW narrow-groove process to vertical and horizontal welds, 8-inch thick field demonstration/qualification welds, and welding procedure handbook. Procedure qualification records [TQ 339] are given for the gas tungsten arc-hot wire welding of 2 1/4 Cr - 1 Mo steel. (DLC)

30623 **Double summation procedure for the combination of seismic responses of multiply-excited piping systems.** Sundararajan, C. (EDS Nucl Inc, San Francisco, Calif). *American Society of Mechanical Engineers, [Paper] ;* No. 80-WA/PVP-1, 1-4(Nov 1980).

The multiple response spectrum method of seismic analysis is becoming popular to analyze piping systems subjected to different excitations at different supports or support groups. In this method the maximum responses due to each excitation in each mode of vibration are calculated separately by the response spectrum method, and then the responses due to each excitation are combined suitably to obtain the total modal responses. In this paper a more rational double summation procedure is derived, and the theoretical basis and approximations involved are discussed. 10 refs.

30624 **Plastic fracture mechanics prediction of fracture instability in a circumferentially cracked pipe in bending--2. Experimental verification on a Type 304 stainless steel pipe.** Wilkowski, G.M.; Zahoor, A.; Kanninen, M.F. (Battelle, Columbus Lab, Ohio). *American Society of Mechanical Engineers, [Paper] ;* No. 80-WA/PVP-4, 1-10(Nov 1980).

The possibility of a pipe fracture emanating from a stress corrosion crack in the heat-affected zones of girth-welds in Type 304 stainless steel pipes was investigated. The J-resistance curve--tearing modulus parameter for the prediction of crack initiation, stable growth and fracture instability--was employed. In the actual experiment, the onset of fracture instability occurred beyond maximum load at an average stable crack growth of 16 to 19 mm (0.63 to 0.75-in.) at each tip. 6 refs.

30625 **Annual book of ASTM standards. Part 45. Nuclear standards.** Philadelphia, PA; American Society for Testing and Materials (1980). 1320p. $49.00.

The standards are assembled in each part in alphanumeric sequence of their ASTM designation numbers. Each part has two tables of contents: a list of the standards in alphanumeric sequence of their ASTM designations; and a list of the standards classified according to subject. A subject index of the standards and tentatives in each part appears at the back of each volume. This part contains standards concerning concrete products for nuclear applications; graphite products for nuclear applications; metal products for nuclear applications; nuclear-grade materials; radiation effects in organic materials; radioactivity, inorganic materials in water; analysis, dosimetry, and radiation effects in metals; matrix analysis for energy applications; temperature measurement; and protective coating and lining work for power generation facilities.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 30923

2204 Control Systems

30626 **(DOE/SF/70005—T2) Control assembly development: Task 5-absorber studies, heating experiments, design studies. Annual report.** Specht, E.R.; Springer, T.H.; Otter, J.M.; Anderson, R.V. (Rockwell International Corp., Canoga Park, CA (USA)). 1974. Contract AT03-76SF70005. 37p. NTIS, PC A03/MF A01. Order Number DE81026152.

The overall objectives of the Control Assembly Development Program consist of evaluations and analytical studies of reactor control materials in environments typical of fast reactors, and the testing of various materials, systems, and mockups in order to permit the design of reliable and effective control rods for full-scale LMFBR systems. The program encompasses measurements of heating rates and cooling requirements in control rods having typical geometrical arrangements of absorber pins, studies of the behavior of the absorber material as a result of irradiation in the reactor environment, and the analytical study and design of control rod systems.

30627 **(HEDL-SA—2236-FP) Helium diffusion in irradiated boron carbide.** Hollenberg, G.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1981. Contract AC14-76FF02170. 18p. (CONF-810528—10). NTIS, PC A02/MF A01. Order Number DE81027848.

From 83. symposium on nucleation and crystallization in glasses; Washington, DC, USA (3 May 1981).

Boron carbide has been internationally adopted as the neutron absorber material in the control and safety rods of large fast breeder reactors. Its relatively large neutron capture cross section at high neutron energies provides sufficient reactivity worth with a minimum of core space. In addition, the commercial availability of boron carbide makes it attractive from a fabrication standpoint. Instrumented irradiation experiments in EBR-II have provided continuous helium release data on boron carbide at a variety of operating temperatures. Although some microstructural and compositional variations were examined in these experiments most of the boron carbide was prototypic of that used in the Fast Flux Test Facility. The density of the boron carbide pellets was approximately 92% of theoretical. The boron carbide pellets were approximately 1.0 cm in diameter and possessed average grain sizes that varied from 8 to 30 μm. Pellet centerline temperatures were continually measured during the irradiation experiments.

30628 **Scram signal generator.** Johanson, E. W.; Simms, R. (to Department of Energy). US Patent 4,253,093. 24 Feb 1981. Filed date 15 May 1979. vp.

A scram signal generating circuit for nuclear reactor installations monitors a flow signal representing the flow rate of the liquid sodium coolant which is circulated through the reactor, and initiates reactor shutdown for a rapid variation in the flow signal, indicative of fuel motion. The scram signal generating circuit includes a long-term drift compensation circuit which processes the flow signal and generates an output signal representing the flow rate of the coolant. The output signal remains substantially unchanged for small variations in the flow signal, attributable to long term drift in the flow rate , but a rapid change in the flow signal, indicative of a fast flow variation, causes a corresponding change in the output signal. A comparator circuit compares the output signal with a reference signal, representing a given percentage of the steady state flow rate of the coolant, and generates a scram signal to initiate reactor shutdown when the output signal equals the reference signal.

30629 **Operational, control and protective system transient analyses of the closed-cycle GT-HTGR power plant.** Openshaw, F.L.; Chan, T.W. (Gen At Co, San Diego, Calif). *American Society of Mechanical Engineers, [Paper] ;* No. 80-WA/GT-1, 1-11(Nov 1980).

This paper presents a description of the analyses of the control/protective system preliminary designs for the gas turbine, high-temperature gas-cooled reactor (GT-HTGR) power plant. The purpose of these systems is the control and safe operation of the plant in accordance with utility practice for large nuclear generation stations, and in the event of an abnormal or accident condition. The GT-HTGR dynamic modeling, control/protective system design, and transient analyses are illustrated in this paper through discussion of a few selected transient events and the special modeling and control operation for these events. 10 refs.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 31036

30630 **(PNL—3584) Impacts of uranium-utilization improvements on light-water-reactor radionuclide releases.** Aaberg, R.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1981. Contract AC06-76RL01830. 26p. NTIS, PC A03/MF A01. Order Number DE81028363.

This report discusses potential changes to radionuclide releases as a result of uranium-saving plant modifications and altered operating practices. Only releases to the environment from routine operation are considered; releases resulting from abnormal conditions outside the technical specifications covering plant operation are not considered.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 30615, 30642, 30643

30631 **(HEDL-UOR—79-034) Inadvertent raising of levels in the FFTF primary sodium pumps. Final unusual occurrence report, HEDL 79-34 (FFTF-58).** Kuechle, J.D. (Hanford Engineering Development Lab., Richland, WA (USA)). 9 Apr 1981. Contract AC14-76FF02170. 6p. NTIS, PC A02/MF A01. Order Number DE81027563.

The final unusual occurrence report describes the inadvertent raising of the sodium level in the FFTF primary sodium pumps during system testing. This event is now judged to have caused permanent deformation of the primary pump shaft on loop 1 during a period when pump rotation was stopped and sodium level in the pump tank was inadvertently increased. The shaft was subsequently removed, straightened, and returned to service in the spare FFTF pump.

30632 **(HEDL-UOR—79-048) Final unusual occurrence report: HEDL 79-48 (FFTF-67). Inadvertent overpressurization of an FFTF secondary sodium system expansion tank.** Kuechle, J.D. (Hanford Engineering Development Lab., Richland, WA (USA)). 8 Apr 1981. Contract AC14-76FF02170. 6p. NTIS, PC A02/MF A01. Order Number DE81027541.

The final unusual occurrence report describes the inadvertent overpressurization of a secondary sodium system expansion tank at FFTF and an attendant rupture of the rupture discs.

30633 **(LA—7121-H-Rev.) Thirty-five years at Pajarito Canyon Site.** Paxton, H.C. (Los Alamos National Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 61p. NTIS, PC A04/MF A01. Order Number DE81026431.

A history of the research activities performed at the Pajarito Canyon Site from 1946 to 1981 is presented. Critical assemblies described include: the Topsy assembly; Lady Godiva; Godiva 2; Jezebel; Flattop; the Honeycomb assembly for Rover studies; Kiwi-TNT; PARKA reactor; Big Ten; and Plasma Cavity Assembly.

30634 **Creep relaxation of fuel pin bending and ovalling stresses.** Chan, D.P.; Jackson, R.J. (Westinghouse Hanford Co, Richland, Wash). *American Society of Mechanical Engineers, [Paper] ;* No. 80-C2/NE-24, 1-7(Aug 1980).

Analytical methods for calculating fuel pin cladding bending and ovalling stresses due to pin bundle-duct mechanical interaction taking into account nonlinear creep are presented. Calculated results are in close agreement with finite element results by the MARC-CDC program. The methods are used to investigate the effect of creep on the FTR fuel cladding bending and ovalling stresses. 6 refs.

30635 **(DOE/SF/00824—T17) Sodium technology.** Kurzeka, W.J.; Oliva, R.M.; Horton, P. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). [nd]. Contract AM03-76SF00824. 29p. NTIS, PC A03/MF A01. Order Number DE81026157.

The objective of this program is to conduct friction screening tests in an environment of high-temperature, high-purity liquid sodium or sodium vapor to: (1) develop backup materials, processes, and vendors for core component wear pads, (2) investigate material treatments and coatings for improvement of wear behavior of common LMFBR structural materials, (3) evaluate weld-deposited hardfacings and/or prefabricated bearing materials for use in long-term, high-temperature, high-fluence regions, (4) evaluate bearing materials with a low potential for change in surface composition due to corrosion or mass transfer effects, and (5) develop statistical confidence in friction values for selected material combinations.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 30629

30636 **(CONF-810804—11) Analytical and experimental simulation of boiling oscillations in sodium with a low-pressure water system.** Levin, A.E.; Griffith, P. (Oak Ridge National Lab., TN (USA); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). 1981. Contract W-7405-ENG-26. 29p. NTIS, PC A03/MF A01. Order Number DE81028571.

From National heat transer conference; Milwaukee, WI, USA (2 Aug 1981).

An experimental and analytical program designed to simulate sodium boiling under low-power, low-flow conditions has been completed. Experiments were performed using atmospheric- pressure water as a simulant fluid and a simple one-dimensional model was developed for the system. Results indicate that water is a suitable simulant for liquid sodium under certain conditions and that the model does a fair job of modeling the system. In addition, oscillations that occur during the boiling process appear to augment substantially the heat transfer between liquid and vapor in condensation.

30637 (DOE/ET/37218—T1) Sodium boiling in LMFBR fuel assemblies. Progress report. (Massachusetts Inst. of Tech., Cambridge (USA)). 30 Apr 1981. Contract AS02-78ET37218. 37p. NTIS, PC A03/MF A01. Order Number DE81027868.

Objective is to improve current understanding of sodium voiding behavior under postulated LMFBR accident conditions. Multi-dimensional computer models are being developed under low flow and low power conditions. The following computer codes are being developed and assessed: NATOF-2D, THERMIT-S-6E, and THERMIT-S-4E. The effect of virtual mass on the characteristics and numerical stability in two-phase flows was studied. (DLC)

30638 (DOE/SF/74028—T5) Accident Debris behavior. Quarterly progress report, October-December 1977. Johnson, R.P.; Nelson, C.T.; Vaughn, E.U.; Guderjahn, C. (Rockwell International Corp., Canoga Park, CA (USA)). 1977. Contract AT03-76SF74028. 22p. NTIS, PC A02/MF A01. Order Number DE81025786.

The following substasks are reported: aerosol leakage (multiple bend leak path, model of duct plugging by aerosols), high-temperature-concentration aerosol tests, and large-scale molten fuel - carbon steel tests. 14 figures, 1 table. (DLC)

30639 (EGG-M—02881) Fission product signatures measured during the PBF power cooling mismatch and reactivity initiated accident experiments. Osetek, D.J.; Croucher, D.W.; King, J.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 25p. (CONF-810667—2). NTIS, PC A02/MF A01. Order Number DE81028275.

From Enlarged halden programme group meeting on process computer applications; Fredrikstad, Norway (14 Jun 1981).

Fission product release from light water reactor-type fuel rods to the coolant loop during design basis accident tests is the subject of this paper. One of the tests was a power-cooling-mismatch test in which a single fuel rod was operated in film boiling beyond failure. Other tests discussed include reactivity initiated accident (RIA) tests, in which the fuel rods failed as a result of power bursts that produced radial-average peak fuel enthalpies ranging from 250 to 350 cal/g. One of the RIA tests included two previously irradiated fuel rods. On-line gamma spectroscopic measurements of short-lived fission products and important aspects of fission product behavior observed during the tests are also discussed. Time-dependent release fractions for short-lived fission products are presented and compared with release fractions suggested by the Reactor Safety Study, NRC Regulatory Guides, and measurements from the Three Mile Island accident.

30640 (GA-A—16291) Single model for the performance of HEU/LEU fissile and ThO_2 fertile fuel under hypothetical accident conditions. Goodin, D.T. (General Atomic Co., San Diego, CA (USA)). May 1981. Contract AT03-76ET35300. 28p. (CONF-810528—9). NTIS, PC A03/MF A01. Order Number DE81028558.

From 83. symposium on nucleation and crystallization in glasses; Washington, DC, USA (3 May 1981).

The performance of TRISO coated highly enriched uranium/low-enriched uranium fissile and ThO_2 fertile fuel particles was studied under simulated accident conditions at temperatures up to 2700°C. A total of 1663 fuel particles from eight different irradiation capsules with burnups covering the range of design conditions has been tested. The test data have shown very low failure fractions compared with predictions of previous models and provide the empirical basis for a single model for TRISO coating performance.

30641 (HEDL-SA—2305) Test system to simulate transient overpower LMFBR cladding failure. Barrus, H.G.; Feigenbutz, L.V. (Hanford Engineering Development Lab., Richland, WA (USA)). 14 Jan 1981. Contract AC14-76FF02170. 29p. (CONF-810606—86). NTIS, PC A03/MF A01. Order Number DE81027845.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

One of the HEDL programs has the objective to experimentally characterize fuel pin cladding failure due to cladding rupture or ripping. A new test system has been developed which simulates a transient mechanically-loaded fuel pin failure. In this new system the mechanical load is prototypic of a fuel pellet rapidly expanding against the cladding due to various causes such as fuel thermal expansion, fuel melting, and fuel swelling. This new test system is called the Fuel Cladding Mechanical Interaction Mandrel Loading Test (FCMI/MLT). The FCMI/MLT test system and the method used to rupture cladding specimens very rapidly to simulate a transient event are described. Also described is the automatic data acquisition and control system which is required to control the startup, operation and shutdown of the very fast tests, and needed to acquire and store large quantities of data in a short time.

30642 (HEDL-SA—2326-FP) FFTF operating experience with sodium natural circulation: slides included. Burke, T.M.; Additon, S.L.; Beaver, T.R.; Midgett, J.C. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Contract AC14-76FF02170. 33p. (CONF-810606—88). NTIS, PC A03/MF A01. Order Number DE81027846.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

The Fast Flux Test Facility (FFTF) has been designed for passive, back-up, safety grade decay heat removal utilizing natural circulation of the sodium coolant. This paper discusses the process by which operator preparation for this emergency operating mode has been assured, in paralled with the design verification during the FFTF startup and acceptance testing program. Over the course of the test program, additional insights were gained through the testing program, through on-going plant analyses and through general safety evaluations performed throughout the nuclear industry. These insights led to development of improved operator training material for control of decay heat removal during both forced and natural circulation as well as improvements in the related plant operating procedures.

30643 (HEDL-SA—2470) Accommodation of potential hydrogen formation in LMFBR accidents. Stepnewski, D.D.; Peak, R.D.; Mahaffey, M.K. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Contract AC14-76FF02170. 33p. (CONF-810836—1). NTIS, PC A03/MF A01. Order Number DE81027288.

From 3. international seminar on the containment of fast breeder reactors; Ispra, Italy (24 Aug 1981).

Results of design verification tests for the FFTF reactor cavity liner system are presented which suggest that steel liners would retain their integrity even under certain hypothetical accident conditions, thus avoiding the formation of hydrogen. When liner failures are postulate in hypothetical reactor vessel meltthrough accidents, hydrogen levels can be controlled by an air purging system. The design of a containment purging and effluent scrubbing system is discussed.

30644 (NUREG/CR—1776) Aerosol measurements and modeling for fast reactor safety. Annual report for FY 1979. Progress report, 1 October 1978-30 September 1979. Gieseke, J.A.; Lee, K.W.; Jordan, H.; Schumacher, P.M.; Schmidt, E.W. (Battelle Columbus Labs., OH (USA)). Oct 1980. 113p. NTIS, PC A06/MF A01.

Technical progress for FY 1979 is summarized on topics concerned with the HAARM-3 code validation, reference code development, aerosol behavior in a multiple-zone containment, aerosol resuspension, and mixed aerosol properties. The HAARM-3 validation procedure is based on selected dimensionless groups which indicate ranges of predominance for the various mechanisms controlling aerosol behavior. By identifying likely ranges for individual variables and assumed accident conditions, important regimes for experimental verification are identified. The QUICK code has been chosen as a reference aerosol behavior code because of its lack of restrictive assumptions. Comparisons of this code with other codes including the mathematically more complex code CRAB, have demonstrated its accuracy. Differences between the HAARM-3 and QUICK codes were explored as a function of assumed accident conditions. Experiments to determine mobility corrections for describing the motion of agglomerates of UO2 aerosols have been partially completed.

30645 **(NUREG/CR—1822) Steam-water mixing and system hydrodynamics program, Task 4. Quarterly progress report, 1 July-30 September 1980.** Segev, A.; Collier, R.P. (Battelle Columbus Labs., OH (USA)). Nov 1980. 82p. NTIS, PC A05/MF A01.

During this quarter we analyzed results from hot wall tests in the 2/15-scale model and compared the experiment filling curves to those predicted by the mechanistic model. The comparison shows a good agreement for both the large break tests and scaled size break tests.

30646 **(SAND—81-1325) Light water reactor safety technology program. Quarterly report, January-March, 1981.** Dahlgren, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1981. Contract AC04-76DP00789. 56p. NTIS, PC A04/MF A01. Order Number DE81028817.

The Program was initiated in FY 1978 and has evolved during FY 1979 and FY 1980. The areas of activity during the last quarter are reported herein and have been broadly categorized as followes: management support program; risk methods utilization; improved safety systems; man-machine interface; safety data; and utility training.

30647 **Seismic relay testing.** Calhoun, H.J. (Westinghouse Electr Corp, Newark, NJ). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Power Apparatus and Systems ;* **PAS-100**: No. 2, 779-787(Feb 1981).

This paper gives insight into the steps taken by the industry to enhance the safety of nuclear energy by focusing on protective relays used in generating stations. It also shows how one manufacturer evaluates products intended for use in that environment. Westinghouse has established a test program which used the technology available today. This program is implemented with equipment which can be adapted to future advances in technology. Paper No. F 79 828-5. 1 ref.

30648 **LMFBR loss of flow simulations in the sodium loop safety facility.** Ragland, W.A. (Argonne Natl Lab, Ill). *American Society of Mechanical Engineers, [Paper] ;* No. 80-C2/NE-22, 1-8(Aug 1980).

A series of three LMFBR unprotected loss of flow accidents has been simulated in the Sodium Loop Safety Facility. The results of these in-reactor experiments verify that the dynamics of sodium voiding are, in general, well represented by current single channel slug expulsion models. Some refinement in the models in the very early stages of voiding would be desirable to account for minor two dimensional effects. However, cladding motion is not as well understood and current modeling does not accurately predict all of the aspects of blockage formation. Two of the three experiments produced partial rather than complete upper blockages, as had been predicted. Predictions of time of fuel melting appear relatively accurate. 3 refs.

30649 **Thermal response of a molten pool with STEFAN type boundary conditions.** Gasser, R.D.; Pratt, W.T. (Brookhaven Natl Lab, Upton, NY). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-9, 1-5(Jul 1980).

A model is described which treats the melting penetration of an internally heated molten pool into a solid substrate. The model was formulated specifically to study the thermal interaction of molten core material with an MgO sacrificial bed core catcher for a nuclear reactor under post accident conditions. The model includes options for the downward heat transfer coefficient, the existence of a crust at the pool surface, and coupled radiative heat transfer between the pool surface and structures above the pool. 3 refs.

25 ENERGY STORAGE

2501 Magnetic

30650 **(LA-UR—81-2307) Computer-automated controls for superconducting magnetic energy storage.** Criscuolo, A.L. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810833—6). NTIS, PC A02/MF A01. Order Number DE81028697.

From Mechanical, magnetic, and underground energy storage 1981 annual contractors' review meeting; Washington, DC, USA (24 Aug 1981).

A computer-automated control system that allows unmanned operation of the Superconducting Magnetic Energy Storage (SMES) system has been designed and almost completely installed at Los Alamos National Laboratory. In addition to unmanned operation, the computer offers continual monitoring and recording of all the important SMES signals, operator guidance in starting up and maintaining SMES, emergency shutdown control, and high-speed data acquisition for failure diagnosis. The major components of the computer-automated control system are two slave computers that perform the data acquisition and a master computer that performs the control.

2502 Compressed Gas

30651 **(EPRI-EM—1589-Vol.1) Preliminary design study of underground pumped hydro and compressed-air energy storage in hard rock. Volume 1. Executive summary. Final report.** (Potomac Electric Power Co., Washington, DC (USA); Acres American, Inc., Columbia, MD). May 1981. Contract AC02-77ET28013. 111p. NTIS, PC A06/MF A01. Order Number DE81029440.

Potomac Electric Power Company (PEPCO) and Acres American Incorporated (AAI) have carried out a preliminary design study of water-compensated Compressed Air Energy Storage (CAES) and Underground Pumped Hydroelectric (UPH) plants for siting in geological conditions suitable for hard rock excavations. The work was carried out over a period of three years and was sponsored by the US Department of Energy (DOE), the Electric Power Research Institute (EPRI) and PEPCO. The study was divided into five primary tasks as follows: establishment of design criteria and analysis of impact on power system; selection of site and establishment of site characteristics; formulation of design approaches; assessment of environmental and safety aspects; and preparation of preliminary design of plant. The salient aspects considered and the conclusions reached during the consideration of the five primary tasks for both CAES and UPH are presented in this Executive Summary, which forms Volume 1 of the series of reports prepared during the study. The investigations and analyses carried out, together with the results and conclusions reached, are described in detail in Volumes 2 through 13 and ten appendices.

30652 **(EPRI-EM—1589-Vol.5) Preliminary design study of underground pumped hydro and compressed-air energy storage in hard rock. Volume 5: site selection. Final report.** (Potomac Electric Power Co., Washington, DC (USA); Acres American, Inc., Columbia, MD). Apr 1981. Contract AC02-77ET28013. 148p. NTIS, PC A07/MF A01. Order Number DE81028199.

This volume documents a six-step site selection process undertaken to identify and subsequently rank potential sites suitable for either an underground pumped hydroelectric (UPH) facility, or a water-compensated hard-rock cavern compressed air energy storage (CAES) facility. The region of study was confined to the service area of the Potomac Electric Power Company (PEPCO) and contiguous areas. Overriding considerations related to geology, environmental impact and transmission-line routing were studies within the context of minimizing plant costs. The selection process led to the identification of several sites suitable for the development of either a CAES or an UPH facility. Design development and site exploration at the selected site are described in other volumes of the final report.

30653 **(EPRI-EM—1589Vol.9) Preliminary design study of underground pumped hydro and compressed-air energy storage in hard rock. Volume 9. Design approaches: CAES. Final report.** (Acres American, Inc., Columbia, MD). Apr 1981. Contract AC02-77ET28013. 191p. NTIS, PC A09/MF A01. Order Number DE81027704.

During Task 3C of the PEPCO/CAES study detailed design requirements and alternate designs were developed for the major components and systems of the CAES plant. Based upon a preliminary economic and technical evaluation, preferred designs were chosen as the basis for subsequent development in Task 5C. It

should be noted that in some instances design developments during Task 5C may have substantially altered the preferred design. Volume 9, Design Approaches - CAES, presents a summary of the project design criteria, pressure optimization study and the design approaches for the major plant systems which are developed in more detail in Appendices A through E. In addition, Volume 9 presents the performance, operation and control capabilities of the plant and the results of the preliminary cost estimate prepared in Task 3 which will be updated in Volume 12, Plant Design - CAES.

30654 **(EPRI-EM—1589-Vol.9-App.D) Preliminary design study of underground pumped hydro and compressed-air energy storage in hard rock. Volume 9. Design approaches: CAES; Appendix D: mechanical systems.** (Potomac Electric Power Co., Washington, DC (USA); Acres American, Inc., Columbia, MD). Apr 1981. Contract AC02-77ET28013. 104p. NTIS, PC A06/MF A01. Order Number DE81028200.

This appendix documents the development of the design approach taken for the mechanical systems included in a Compressed Air Energy Storage (CAES) facility. Mechanical systems comprise the fuel oil system, water supply system, waste treatment system, fire protection and safety system, and miscellaneous plant services. The design approaches developed for these systems are based on similar designs for conventional utility plants because the operating characteristics, design parameters, and equipment capabilities for CAES plant mechanical systems are similar to standard utility systems. The design approach for each of these systems develops several alternatives for achieving the CAES plant requirements in each area. The preferred alternative is then expanded into a preliminary system description.

30655 **(EPRI-EM—1589-Vol.12) Preliminary design study of underground pumped hydro and compressed-air energy storage in hard rock. Volume 12. Plant design: CAES. Final report.** (Potomac Electric Power Co., Washington, DC (USA); Acres American, Inc., Columbia, MD). Apr 1981. Contract AC02-77ET28013. 285p. NTIS, PC A13/MF A01. Order Number DE81028110.

During Task 5C of the PEPCO/CAES study detailed designs were developed for the major components and systems of the CAES plant. These designs were based upon the preliminary economic and technical evaluations and alternative designs developed in Task 3C. Volume 12, Plant Design - CAES, presents the detailed project design drawings for the major plant systems and structures. In addition, Volume 12 presents the site development report, updated cost estimate, cost/schedule risk study, reliability/availability analysis, and recommendations for additional research and development.

2503 Pumped Hydro

REFER ALSO TO CITATION(S) 30113, 30115, 30117, 30651, 30652

30656 **(DOE/TIC—1028678) Feasibility of a small scale pumped storage demonstration project, Hibbing, Minnesota.** (EG and G Idaho, Inc., Idaho Falls (USA); Hibbing Public Utilities Commission, MN (USA)). 1981. Contract AC07-76ID01570. 229p. (IDO—10097). NTIS, PC A11/MF A01. Order Number DE81028678.

A public utilities company operates an electric utility system and district heating system in Hibbing, Minn. using a coal-fired cogeneration plant. Supplementary power for peak loads is purchased from the Minnesota Power and Light Co. The substitution of power from a pumped storage facility for the purchased peak power is potentially advantageous because: the coal-fired cogeneration plant could operate with an improved heat rate; numerous open pits from abandoned iron ore mines are available as reservoirs for pumped storage; and the peaking power generated would not depend on petroleum fuel as would be the case if an oil-fired diesel unit or gas turbine unit were used for peak power generation. Therefore the economic feasibility and technical feasibility of developing a 5 to 15 MW pumped storage power plant were examined. This study concluded that: 8 mine sites would be suitable for pumped storage; oil-fired peak power units should be avoided due to uncertainties in fuel supplies; the efficiency of the existing cogeneration plant would be improved; this is a non-polluting form of power generation; and the development in the US of small-scale reversible pump/turbine units for commercial operation is desirable. It is recommended that Hibbing, Minn. seek financial assistance from the Dept. of Energy to develop a small demonstration pumped storage project in the 5 to 15 MW range using an existing inactive iron ore mine pit as the reservoir. (LCL)

2505 Flywheels

REFER ALSO TO CITATION(S) 30903, 30904

30657 **(PB—81-800450) Design and applications of Flywheels. November 1979-October 1980 (citations from the Engineering Index Data Base). Report for November 1979-October 1980.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Nov 1980. 55p. NTIS PC N01/MF N01.

The design and varied applications of flywheels and reaction wheels are investigated in these research reports gathered in a worldwide literature survey. Such diversified applications as satellite stabilization, surface vehicle propulsion, energy transfer devices, and inertia or friction welding are reviewed. (This updated bibliography contains 48 citations, all of which are new entries to the previous edition.)

30658 **(PB—81-800468) Design and applications of flywheels. 1970-October 1979 (citations from the Engineering Index Data Base). Report for 1970-October 1979.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Nov 1980. 273p. NTIS PC N01/MF N01.

The design and varied applications of flywheels and reaction wheels are investigated in these research reports gathered in a worldwide literature survey. Such diversified applications as satellite stabilization, surface vehicle propulsion, energy transfer devices, and inertia or friction welding are reviewed. (This updated bibliography contains 266 citations, none of which are new entries to the previous edition.)

30659 **(PB—81-800476) Design and applications of flywheels. September 1978-October 1980 (citations from the NTIS Data Base). Report for September 1978-October 1980.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Nov 1980. 173p. NTIS PC N01/MF N01.

The design and varied applications of flywheels and reaction wheels are investigated in these Government-sponsored research reports. Such diversified applications as satellite stabilization, surface vehicle propulsion, energy transfer devices, and inertia or friction welding are reviewed. (This updated bibliography contains 166 citations, 73 of which are new entries to the previous edition.)

2506 Thermal

REFER ALSO TO CITATION(S) 30167, 30491, 30492, 30493, 30696, 31080

30660 **(DOE/ET/20195—T1(Vol.1)) Advanced thermal-energy-storage concept-definition study for solar Brayton power plants. Final technical report, Volume I.** (Boeing Engineering and Construction Co., Seattle, WA (USA). Energy and Environment Div.). 1976. Contract AC03-76ET20195. 248p. NTIS, PC A11/MF A01.

The detailed results are presented of a technical and economic assessment of phase change and thermochemical energy storage systems in a solar power plant employing a high temperature Brayton cycle thermal engine with helium as the heat transport fluid. The assessment included an examination of the storage system operation, efficiency, power plant interaction, design, materials, safety, maintenance, environmental impact, system life, and economics. These considerations are implemented in the conceptual design of three baseline storage systems and their components for use in a solar power plant module of 50 megawatt electrical power

output. Rationale is provided to support the configuration, operation and material choices. A preliminary assessment of the technology development and experimental test program requirements are also included. The report is contained in four separate volumes. This volume is the technical report.

30661 **(DOE/RL/10121—T1) Heat pumps for seasonal thermal energy storage: operation and design.** Reistad, G.M.; McMahon, W.R. (Oregon State Univ., Corvallis (USA). Dept. of Mechanical Engineering). Nov 1980. Contract AT06-79RL10121. 80p. NTIS, PC A05/MF A01. Order Number DE81025592.

A study of the design and operation of heat pumps having relevance to annual thermal energy storage has been conducted. The study has consisted of two major aspects in this overall area: (1) a survey of commercial groundwater heat pump installations in the Portland, OR area and (2) analysis of residential-scale water-source heat pumps and their potential application to seasonal thermal energy storage in aquifers. Through the survey, the operational experiences of large heat pumps using groundwater, with or without reinjection, were evaluated. A model of the residential-scale heat pump and aquifer system was made and evaluated for energy performance over a range of parameters for the heat pump, the aquifer and the heating load being met from the heat pump.

30662 **(PB—81-122889) Continuous heat source model for ground heat storage.** Claesson, J.; Johansson, M. (Swedish Council for Building Research, Stockholm). 1980. 33p. NTIS, PC A03/MF A01.

The study presents a model for the simulation of a ground heat storage. The ground volume is penetrated by a duct system for injection and extraction of heat. The heat transfer properties between the ground and such a duct system is here characterized by a heat transfer length. The heat exchange between the soil and the ducts is represented by a heat source/sink distribution in the storage region.

30663 **(PB—81-122947) Swedish energy storage projects 1979. Research-development-full-scale experiments supported by governmental organizations.** Atterkvist, S. (Swedish Council for Building Research, Stockholm). 1980. 144p. NTIS, PC A07/MF A01.

The material contains 94 projects, divided up as follows: general studies and comparisons of storage methods; sensible storage in water; sensible storage in ground and rock; sensible storage in parts of building structures; latent storage; thermochemical storage; batteries; and storage of hydrogen.

30664 **Approximate solution for freezing adjacent to an extended surface.** Griffin, F.P.; Smith, R.N. (Oak Ridge Natl Lab, Tenn). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-8, 1-10(Jul 1980).

A two-dimensional integral solution is proposed to the problem of solidification in a rectangular enclosure in which the end wall temperatures are fixed and the side walls are conducting. The physical situation being modeled is that of a finned surface array extending into a freezing phase change material (PCM), for example in a latent heat thermal storage system. Relations for the PCM temperature profile and the location of the phase front are assumed in terms of two unknown time functions. The fin temperature distribution is then obtained analytically. A second required integral equation is obtained through an approximation, which should be valid at small times, that the heat transfer from the PCM to the fin should be independent of that from the PCM to the end wall. 15 refs.

2508 Chemical

REFER ALSO TO CITATION(S) 30663

2509 Batteries

REFER ALSO TO CITATION(S) 30901

30665 **(DOE/ET/13390—T2) Iron-air battery development program. Interim report 1978.** Buzzelli, E.S.; Liu, C.T.; Bryant, W.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). May 1980. Contract AC02-76ET13390. 71p. (COO—2949-2). NTIS, PC A04/MF A01. Order Number DE81025167.

The research and development efforts of the program at the Westinghouse Electric Corporation on iron-air batteries during the period June 1977 to May 1978 are described. This battery is being developed as an advanced battery system for electric-vehicle propulsion. Objectives for both electrodes and cells have been established to be compatible with a final fully-engineered battery which will ultimately store greater than 140 Wh/kg and deliver greater than 100 W/kg. Work during this portion of the program has emphasized the cell testing aspects of the iron-air system along with individual electrode improvement. The cyclic voltage efficiency of 100 cm^2 size cells has been shown to be in excess of 50% with individual iron and air electrode performance characteristics comparable or superior to those characteristics established in the half cell testing program. Long-term cyclic stability for greater than 100 cycles has been established for several 100 cm^2 size cells. Work, presently underway, and tests planned in the near future, are expected to demonstrate the near-term expected performance characteristics of the iron-air cells. Additional studies are underway to improve the performance characteristics of the individual electrodes through improved processing procedures and to incorporate these improvements into the cell test program.

30666 **(DOE/ET/29079—T1) Advanced converter technology. Technical progress report, May 23, 1979-May 22, 1980.** Banic, C.V.; Eckhouse, S.A.; Kornbrust, F.J.; Lipman, K.; Peterson, J.L.; Rosati, R.W. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 1980. Contract AC01-79ET29079. 144p. NTIS, PC A07/MF A01. Order Number DE81027893.

The overall objective of this program is to define an advanced converter system employing 1980's technology in all subsystem and component areas for use in electrochemical energy storage systems. Additional experimental effort will validate elements of the advanced commutation circuitry on a full-scale breadboard basis. Improved models of battery electrical characteristics are beng defined and experimental apparatus is being designed to measure these characteristics and to enable better definition of the battery-power conditioner interface. Improvement of energy-storage system performance through modification of battery converter characteristics will also be investigated. During this first year of the contract, a new more advanced concept for power conditioning based on a concept defined by United Technologies Corporation for fuel cell use was evaluated. This high switching frequency concept has the potential for significantly reducing the size and cost of battery plant power conditioners. As a result, the Department of Energy authorized redirection of the program to first evaluate this new concept and then to reorient the program to adopt this concept as the primary one. Progress is reported. (WHK)

30667 **(NASA-TM—81771) Characterization, performance, and prediction of a lead-acid battery under simulated electric vehicle driving requirements.** Ewashinka, J.G.; Bozek, J.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1981. Contract AI01-77CS51044. 25p. (DOE/NASA/51044—19). NTIS, PC A02/MF A01. Order Number DE81028871.

A state-of-the-art 6-V battery module in current use by the electric vehicle industry was tested at the NASA Lewis Research Center to determine its performance characteristics under the SAE J227a driving schedules, B, C and D. The primary objective of the tests was to determine the effects of periods of recuperation and long and short periods of electrical regeneration in improving the performance of the battery module and hence extending the vehicle range. A secondary objective was to formulate a computer program that would predict the performance of this battery module for

the above driving schedules. The results show excellent correlation between the laboratory tests and predicted results. The predicted performance compared with laboratory tests was within +2.4 to -3.7 percent for the D schedule, +0.5 to -7.1 percent for the C schedule, and better than -11.4 percent for the B schedule.

30668 **(PB—81-120263) Battery. Report No. 10.** (Indian Lead Zinc Information Centre, New Delhi). Nov 1980. 29p. NTIS, PC A03/MF A01.

The following topics are discussed: outlook for lead, zinc and cadmium in India; future for lead production and recycling--a British view; AKERLOW lead recovery plant; expanded lead battery grids; resume of first solder seminar in India; automatic paste soldering adds sparks to zinc-carbon batteries; 122-ton lead battery used for testing BEST facility; press release on Pb 80; Research and development; and second international symposium on industrial and oriented basic electrochemistry.

30669 **Method of preparing porous, rigid ceramic separators for an electrochemical cell.** Bandyopadhyay, G.; Dusek, J.T. (to Department of Energy). US Patent 4,244,898. 13 Jan 1981. Filed date 30 Mar 1979. vp.

PAT-APPL-025629.

Porous, rigid separators for electrochemical cells are prepared by first calcining particles of ceramic material at temperatures above about 1200° C. For a sufficient period of time to reduce the sinterability of the particles. A ceramic powder that has not been calcined is blended with the original powder to control the porosity of the completed separator. The ceramic blend is then pressed into a sheet of the desired shape and sintered at a temperature somewhat lower than the calcination temperature. Separator sheets of about 1 to 2.5 mm thickness and 30 to 70% porosity can be prepared by this technique. Ceramics such as yttria, magnesium oxide and magnesium-aluminum oxide have advantageously been used to form separators by this method.

30670 **Independent Battery Manufacturers Association 1980 convention.** Largo, FL; Independent Battery Manufacturers Association, Incorporated (1981). 53p. (CONF-8010207—).

From Independent Battery Manufacturers Association 1980 convention; Chicago, IL, USA (15 Oct 1980).

Topics discussed include alloys for the 80's, internal and external security, simplification of reclaiming lead oxide paste, pitfalls of estate planning, and effective time management. Also, short papers presented at the manufacturing workshop, marketing workshop, internal management workshop, and the environmental workshop are included. Individuals present and companies represented at the meeting are listed. (WHK)

29 ENERGY PLANNING AND POLICY

30671 **(DOE/EIA/10752—T2) Analytical and policy issues in energy economics: selected bibliography.** (Charles River Associates, Inc., Boston, MA (USA)). 1981. Contract AC01-81EI10752. 15p. NTIS, PC A02/MF A01. Order Number DE81026208.

Subjects include general readings, petroleum issues, vertical integration, diversification, coal, uranium, and special energy topics such as taxes, competition, deregulation and energy security. (GHT)

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 30673, 30700, 30703, 30704, 30705, 30790, 30791, 30793, 30794, 30817, 30858, 30860, 30866

30672 **(P—101-80-008) California energy demand 1980 to 2000: revised forecast for consideration in the proceedings on the Third Biennial report. Volume I. Technical report.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Nov 1980. 380p. California Energy Commission, Sacramento, CA. Order Number DE81903658.

This report, in a final revised edition, presents the staff forecasts of electricity and natural gas demand for consideration in the proceedings leading to the Third Biennial Report. It contains revised forecasts prepared subsequent to issuance of the preliminary staf forecast of June 3, 1980, including major sections devoted to input assumptions, conservation savings, final forecast results, detailed end-use and industry results by service area, and complete methodological description of all model changes since preparation of complete documentation in October 1979. The report is intended to be a detailed description of input assumptions, conservation analysis, and results which can, in conjunction with the October 1979 Technical Documentation, be used by technical researchers to analyze the complex models used by the CEC staff for forecasting electricity and natural gas demand. This edition documents the final staff demand forecast of September 22, 1980, which corrected several computational errors contained in the original document.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 29931, 29950, 29951, 29952, 29953, 29954, 30112, 30121, 30533, 30684, 30687, 30702, 30719, 30720, 30768, 30845, 30859, 31201, 31210, 31211, 31212, 31213, 31214, 31215, 31216, 31217, 31218, 31225, 31226

30673 **(BNL—29747) Modelling energy-economic interactions in developing countries: a linear-programming approach.** Meier, P.; Mubayi, V. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 51p. (CONF-810726—2). NTIS, PC A04/MF A01. Order Number DE81026048.

From 9. international conference on operational research; Hamburg, F.R. Germany (23 Jul 1981).

This paper describes a new BNL energy-economic assessment model for application to energy assessments in developing countries. The short comings of previous BNL models to assess energy in developing countries are discarded. Emphasis of the new model is on a simple, comprehensive treatment of the energy sector: the enormous end-use sector detail of BESOM is discarded but, on the other hand, previously absent detail in the petroleum-product sector is added. The input-output model is directly incorporated in the Energy system LP as a set of additional constraints, as are some generic industry-process models that capture important technological options in the major energy-using industries (such as steel and cement) where fuel-substitution opportunities are significant from an overall national perspective. Finally, the major supply sectors, as well as the major energy-using industries, are modelled as capacity-expansion problems, in which explicit distinction is made between capital stock and energy flows. Objections are twofold. First, the huge data requirements preclude meaningful analysis: even if it were possible, say, to estimate non-linear cost functions (one of the putative benefits of network traversal algorithms being the ability to handle almost any functional specification) the degree of precision may be entirely spurious. Second, and more importantly, for most developing countries the notion of energy supply curves is far-fetched, since energy prices are set by planning authority, not established by market clearing equilibrium. To be sure, such models will yield that equilibrium prices should be: but these can just as easily be established from the shadow prices of a more simple linear program.

30674 **(BNL—29881) Project impact analysis as an optimal control problem.** Anandalingam, G. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 43p. (CONF-810542—5). NTIS, PC A03/MF A01. Order Number DE81028465.

From Joint meeting of the Institute of Management Sciences and Operations Research Society; Toronto, Canada (6 May 1981).

This paper analyzes the effects of a major investment project on a multi-sector less developed economy. Single investment projects with external effects reaching across the entire economy are frequently encountered in developing countries. This study concentrates on the Mahaweli Ganga Development Project in Sri Lanka, a multi-dam irrigation and hydroelectric power project. The Mahaweli Project calls for an annual investment level, in 1970 prices, of Rs 2200 million (US $150 million) over a period of six years, which is 50 percent of the annual expenditure of the government. The project would thus require a large fraction of total investment over a medium term planning period and would materially alter the existing supply and demand for major goods and serv-

ices. The project is sufficiently large that its effect is economy-wide. The model we use is a dynamic input-output optimizing model having the mathematical structure of an Optimal Control problem.

30675 (DOE/CS/70038—T2) Providing technical assistance to the Energy Development Board of Mercer County. (Resource Planning Associates, Inc., Washington, DC (USA)). 30 Sep 1977. Contract AT03-76CS70038. 49p. NTIS, PC A03/MF A01.

The background and summary of activities of the general organizational approach developed by Resource Planning Associates (RPA) for managing energy-related community development and to test that approach in a specific site are discussed. The general approach was adapted to Mercer County, North Dakota, the setting for the construction of two 2-unit coal-fired power plants and two or more coal-gasification plants, as well as for related coal mining. RPA's activities were designated to provide the local governments of Mercer County the organizational and technical support needed to establish the Energy Development Board (EDB) of Mercer County, to monotor its activities, and to report to ERDA on its progress. Through September 30, 1977, RPA aided in the establishment of the EDB. Activities of RPA are summarized. Information presented in appendices are: summary of Mercer County meetings on August 25 and 26, 1977; presentation to legislative assistants to Senators Burdick and Young; bylaws for the Energy Development Board of Mercer County; and budget for the first year of operation of the EDB of Mercer County. (MCW)

30676 (DOE/CS/71030—T1) Gaining agreement on the charter of an Energy Development Board in Mercer County, North Dakota. (Resource Planning Associates, Inc., Washington, DC (USA)). 30 Sep 1977. Contract AT03-76CS71030. 69p. NTIS, PC A04/MF A01.

Negotiations to formulate Energy Development Board of Mercer County, North Dakota are briefly discussed. The Boards primary function is to plan, coordinate, and assist community development induced by energy developemt and to promote energy conservation and the efficient use of energy resources in the prototype community which is the setting for construction of two 2-unit coal-fired power plants and two or more coal gasification plants, as well as related coal mining. Presented in the appendices are: a summary of proposed terms for a Mercer County Energy Development Agreement; drafts of Mercer County Energy Development Agreements, June 23 and June 24, 1977; Mercer County Energy Development Agreement with amendments; and the final Mercer County Energy Development Agreement. (MCW)

30677 (NP—22596, pp 521-531) **Microeconomic desicionmaking in an unstable macroeconomic environment.** Stalon, C.G. (Illinois Commerce Commission, Springfield). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

The present recession in the US (1980) is discussed; especially discussed are the concerns about the consequences about the next recovery. The purpose of the recession and accomplishing that purpose are addressed. Some problems which have been created and will be created for business in general and for utilities and their regulators are discussed. The inflation-unemployment trade-off and creation of the tradeoff are discussed. In commenting on the economy, the author charges that we as a nation have slipped into the practice of reconciliating economic conflict in a destructive manner. It is recommended that if the social destructiveness of the inflation-unemployment trade-off is to be reduced, the political and economic processes which have led to the present dilemma must be understood and controlled. (MCW)

30678 Cost comparison of energy projects: discounted cash flow and revenue-requirement methods. Phung, D.L. (Oak Ridge Associated Universities, Tenn). *Energy (Oxford)* ; 5: No. 10, 1053-1072(Oct 1980).

Both the discounted cash flow (DCF) and revenue requirement (RR) methods are frequently used in the cost analysis of energy projects. Each is especially well suited in special circumstances. For most forward-looking ventures, the RR method appears to be more useful. This paper provides simple formulations for the two methods and some special cases of interest for costing practices. Both formulations are applicable to either free or regulated enterprises and also under constant-dollars or inflationary conditions. The interpretation of cost results depends on the selection of cash-flow streams and/or the intent of revenue requirements. Several numerical examples are given. 23 refs.

30679 Policy responses to the productivity slowdown. New Haven, CT; Yale University (Jun 1980). 51p. (NP—1903920).

A slowdown in the growth rate of labor productivity in the US (productivity slowdown) is discussed in this review. The generally accepted reasons for the slowdown are presented. A theory of depletion vs obstacle in describing productivity slowdown is presented. Policy responses to problems of productivity slowdown are described. Views presented include: (a) a change of taste toward no growth philosophies; (b) undersaving and underinvesting; (c) self-inflicted wounds i.e. payroll taxes, minimum wage, trade restrictions, etc.; and (d) depletion in extractive industries, investment opportunities, and inventions. Specific policy responses are discussed including: anti-inflation policy; demand management policies; investment; energy; and regulation.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 30551, 30875, 31197, 31198, 31208, 31210, 31214, 31215, 31216, 31217, 31220, 31226

30680 (ATR—76(7518)-2) Documentation of preliminary strategy and implementation plans for environment and safety programs (April 1975). (Aerospace Corp., Germantown, MD (USA). Environment and Energy Conservation Div.). Oct 1975. Contract AT03-76EV70004. 202p. NTIS, PC A10/MF A01. Order Number DE81024293.

In June 1975, in response to requirements in Section 6 of the Federal Nonnuclear Energy Research and Development Act of 1974, the US Energy Research and Development Administration (ERDA) presented to Congress and the President of the United States a comprehensive program plan for national energy research, development, and demonstration. This report, entitled Creating Energy Choices for the Future, bears the document designation ERDA-48 and is comprised of two volumes. Volume I discusses overall program strategy, and Volume II discusses detailed elements of the research, development, and demonstration program implementation plan. Compiled here are the strategy and implementation plans as drafted in April 1975. Elements of these plans are incorporated in the ERDA-48 report; however, the original work in its entirety has not until now been published. The purpose of this document is to provide an organized record of these writings for internal use by the AES staff in a format that is convenient for consultation, reference, and other uses in future ERDA planning activities of this kind. This document is organized in two major parts: Strategy Plans and Implementation Plans. Each part contains an overall summary statement as well as a writeup for each of the program unit activities under the purview of the Office of the Assistant Administrator for Environment and Safety as structured at the time of the original writing.

30681 Environment, energy, public policy: toward a rational future. Axelrod, R.S. (ed.). Contract FG01-79EV10044. Lexington, MA; D.C. Heath and Company (1981). 183p. (CONF-7906130—).

From Conference on energy and environment; Garden City, NY, USA (8 Jun 1979).

An interdisciplinary conference was held at Adelphi University (Garden City, NY) on energy and environmental problems from either an institutional or a policy-process perspective. Nine chapters are included in this proceedings; a separate abstract was prepared for each chapter. (DLC)

30682 Energy and the environment: conflict and resolution. Axelrod, R.S. (Adelphi Univ., Garden City, NY). pp 1-7 of Environment, energy, public policy: toward a rational future. Axelrod, R.S. (ed.). Lexington, MA; D.C. Heath and Company (1981).

From Conference on energy and environment; Garden City, NY, USA (8 Jun 1979).

Concern over the environment resulted in the passage of various environmental-protection legislation in the 1970s. However, the energy crisis threatens the progress in protecting the environment. Cost-effective analysis is not appropriate for resolving the conflict. A comprehensive environmental and energy policy is needed. The author feels that the country is at a critical juncture, and that there is an opportunity to reshape our political institutions and the future. (DLC)

30683 **Disincentives for policy leadership in energy and the environment: the structure of voter opinion.** Laney, N.; Ingram, H. (Arizona Univ., Tucson). pp 15-36 of Environment, energy, public policy: toward a rational future. Axelrod, R.S. (ed.). Lexington, MA; D.C. Heath and Company (1981).

From Conference on energy and environment; Garden City, NY, USA (8 Jun 1979).

This chapter examines the structure of public opinion on energy and environmental matters and explores the implications of these attitudes for legislative action. The data come from a study of voter attitudes in the Four Corners states of Arizona, New Mexico, Colorado, and Utah. The inconsistent and fragmented attitudes that voters hold about energy and environmental issues, well as water issues, make it very difficult for legislators to formulate and support coherent programs. It is likely that energy-environment trade-off questions will continue to be fought out on a piecemeal, issue-by-issue basis as in the past. 10 references, 1 figure, 13 tables. (DLC)

30684 **Notes from no man's land: the politics and ecology of energy research and development.** Rosenbaum, W.A. (Univ. of Florida, Gainesville). pp 61-79 of Environment, energy, public policy: toward a rational future. Axelrod, R.S. (ed.). Lexington, MA; D.C. Heath and Company (1981).

From Conference on energy and environment; Garden City, NY, USA (8 Jun 1979).

During 1980, federal energy R and D expenditures were an estimated $5.4 billion. Major aspects of federal R and D programs have been called no man's land where a policy vacuum invites political resolution such as in the conflict over the nuclear-fuel enrichment plant which was eventually settled at Portsmouth. A breakdown is given of the federal energy R and D expenditures. The nature of the US political system encourages spending on big projects mainly for their economically stimulating effect. The US nuclear and fossil-fuel programs are discussed. Ways for restoring environmental balances in the national energy R and D program are discussed. 30 references. (DLC)

30685 **Energy-environmental trade-offs in the courts: nuclear and fossil fuels.** Wenner, L.M. (Univ. of Illinois, Chicago). pp 81-109 of Environment, energy, public policy: toward a rational future. Axelrod, R.S. (ed.). Lexington, MA; D.C. Heath and Company (1981).

From Conference on energy and environment; Garden City, NY, USA (8 Jun 1979).

Court decisions affecting nuclear and fossil-fuel plants are considered in this chapter. A breakdown of the decisions is given, according to initiator, pro-environment or pro-power decision, and circuit. Of the fossil-fuel power cases, nearly half were decided in favor of the environment, while the preponderance of the nuclear-power cases were decided in favor of power development. The more-favorable attitude of courts toward the environment in fossil-fuel cases is partly due to the role of the Environmental Protection Agency. Since most experts cannot agree about the real costs of any type of energy conversion, the courts are properly used to settle such controversies. 137 references. (DLC)

30686 **Institutional constraints upon environmentally sound energy policy.** Daneke, G.A. (Arizona Univ., Tucson). pp 153-166 of Environment, energy, public policy: toward a rational future. Axelrod, R.S. (ed.). Lexington, MA; D.C. Heath and Company (1981).

From Conference on energy and environment; Garden City, NY, USA (8 Jun 1979).

If the use of energy is merely a means of pursuing life-quality objectives, then energy policy should represent broader social goals. Among such goals, environment integrity would still seem to rank quite high. However, the nation seems bent on general energy situations that are likely to raise serious problems in terms of environmental integrity. Therefore, it is incumbent upon environmental analysts and administrators to bring these fundamental incongruities to the attention of administrative as well as legislative policy makers. This, however, is difficult, at best, under current institutional constraints. External mechanisms are constrained both by the timing and the authority of their inputs, and internal mechanisms are constrained by their lack of access to the process of establishing priorities. These factors need not prevail, however. To the extent that planners and analysts turn their analytical capabilities inward and investigate their role within complex organizations, avenues of access may become apparent. 33 references.

2904 Natural Resources

30687 **(NP—1903562) Analysis of socioeconomic issues and impact of development of the Bravo Dome carbon dioxide field. Final report, February 1, 1980-January 31, 1981.** Nisbett, R.T. (Eastern Plains Council of Governments, Clovis, NM (USA)). Jul 1981. 130p. (EMD—2-68-1504). New Mexico Energy and Minerals Department, Santa Fe. Order Number DE81903562.

The purpose of this study is twofold: (1) to examine the economic base of the region which surrounds the Bravo Dome area; and (2) to analyze the socioeconomic impacts resulting from the development of the Bravo Dome Carbon Dioxide Gas Unit. Baseline data was collected and analyzed in the economic sectors of population; employment; income; retail sales; bank deposits; farms; acreage and value; housing and construction; and utilities. A qualitative description of community services and facilities was included in the economic baseline. A description of the CO_2 energy development includes the use of multiple scenarios allowing for differing sequences of development. In order to analyze the quantitative impacts upon the existing economic base, several economic assumptions were utilized. The economic base or export model was utilized to determine a basic employment multiplier. In order to assess the fiscal impacts, housing demand, and mitigation impacts, a qualitative approach was taken. The qualitative approach does not attempt to precisely determine the impacts in dollar terms, but rather is directed toward identifying potential problems. The final section is a description of mitigation plans and proposals which have been identified by the study. This section includes sources of state funds and federal funds, assistance to local government, and mitigation strategies.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 30699, 30713

30688 **(AD-A—091231) European scientific notes. Volume 34, Number 9.** Burt, W.V.; Peters, D.J. (Office of Naval Research (USA). London Branch Office). 30 Sep 1980. 54p. NTIS, PC A04/MF A01.

This is a monthly publication presenting brief articles concerning recent developments in European Scientific Research. It is hoped that these articles (which do not constitute part of the scientific literature) may prove of value to American scientists by calling attention to current development and to institutions and individuals engaged in these scientific efforts. The articles are written primarily by members of the staff of ORNL and occasionally articles are prepared by, or in cooperation with, members of the scientific staffs of the United States Air Force's European Office of Aerospace Research and Development and the United States ARmy Research and Standardization Group. Articles are also contributed by visiting Stateside scientists.

30689 (DOE/MA—0006/1) Quarterly status of Department of Energy projects. (USDOE Assistant Secretary for Management and Administration, Washington, DC). 31 Mar 1981. 564p. NTIS, PC A24/MF A01. Order Number DE81028704.

The status of each Department of Energy project is summarized on data sheets. Each sheet identifies the project by number, program name, location, and purpose and tabulates the design, construction and total project costs and the project time schedule. The projects are subdivided according to the following categories: conservation and renewable energy; defense programs; environmental protection, safety and emergency preparedness; energy research; environment; fossil energy; nuclear energy; and management and administration. (LCL)

30690 (DOE/RG/10322—T1) Project status report and final report: Economic Regulatory Administration records management support system. (Calculon Corp., Arlington, VA (USA)). 31 Jul 1981. Contract AC01-80RG10322. 3p. NTIS, PC A02/MF A01. Order Number DE81028666.

Progress is reported in three contractually assigned tasks: technical and functional analysis for the office of energy contingency planning; support services for preservation of contingency/emergency planning data; and support for energy emergency plan evaluation and review. (GHT)

30691 CANMET review 1978-1979. Ottawa, Ontario; CANMET-Energy Mines and Resources Canada (1980). 62p. (CANMET—79-25). Canadian Government Publishing Centre, Supply and Services, Hull, Quebec. Order Number DE81903442.

Assuring effective utilization of minerals and energy, developing new technology, and assuring the availability of energy from innovative as well as traditional sources are the prime functions of the Canada Centre for Mineral and Energy Technology. Research focuses on developing alternative resources which lie untapped - oil sands and heavy oils - and on substituting coal for oil and gas for the generation of electrical energy. In minerals technology, the focus is on exploitation of deep-lying, low-grade, complex deposits, recycling of waste products, minimizing environmental damage, and generally maintaining Canada's competitive position. Activities of the branch are planned and implemented through a Minerals Research Program and an Energy Research Program operating across five functional units. The latter comprise Mining Research Laboratories, Mineral Sciences Laboratories, Physical Metallurgy Research Laboratories, Energy Research Laboratories, and Technology Information Division. This review presents highlights during the 1978-1979 fiscal year of the various activities and projects which comprise the two programs. The text is organized according to program structure rather than functional units, thus drawing together related research activities taking place in the various laboratories.

30692 (PB—81-122145) Summary of awards, appropriate technology, fiscal year 1980. (National Science Foundation, Washington, DC (USA). Div. of Intergovernmental Science and Public Technology). 1980. 31p. NTIS, PC A03/MF A01.

Appropriate technologies are defined as those which possess many of the following qualities: they are decentralized, require low capital investment, are amenable to management by their users, result in solutions that conserve natural resources, and are in harmony with the environment. They are also small or intermediate in scale, take into account site-available natural and human resources, and are more labor- than capital-intensive. Under the Appropriate Technology Program, support is given to research on urban innovation; small-scale industrial technology; recycling, resource recovery, and conservation; rural revitalization and the small farm; food and nutrition; and the roles and impacts of appropriate technology on society, the economy, and technological development. Awards for fiscal year 1980 are summarized. Data includes the project title, the principal investigator/project director, performing organization and address, amount of funding, and effective date. Appendices provide the NSF Program Plan for Appropriate Technology, the NSF Program Solicitation for Small Business Innovation Research, and NSF program announcements.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 29946, 30033, 30685, 31276, 31473

30693 Plutonium connection: energy and arms. Salaff, S. *Bulletin of the Atomic Scientists ;* **36**: No. 7, 18-23(Sep 1980).

The opportunity to halt nuclear proliferation dims as commercial rivalries and disputes over the fast breeder reactor isolate the US from Japan and the Western world, and a solution to the radioactive waste problem becomes more remote. Strong political counterforces have slowed breeder reactor development and fuel reprocessing in the US while other countries proceeded with nonmilitary reprocessing by the Purex method and commercial-size breeder reactors. The International Nuclear Fuel Cycle Evaluation (INFE) included 66 nations and five international organizations in a comparison and evaluation of fuel-cycle concepts in terms of economic, environmental, and weapons-proliferation issues. Alternatives to the Purex process include Civex processing and multinational spent-fuel-storage schemes. Only the Candu reactor has led a nation (India) to closing the fuel cycle to produce weapons-grade material and no weapon capability can be traced to nuclear power production. The Non-Proliferation Treaty seeks to reduce both the incentives and the opportunities for this to happen. Japan and West Europe question US motives for the six-year decline in US nuclear power plant ordering since US nuclear weaponry is tied to reprocessing, but the US continues to supply over 75% of the enrichment services on the export market. The trend toward militarization of the trilateral framework makes it inadequate to control proliferation and will continue to breed international crises as East-West relations deteriorate. 21 references. (DCK)

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 30795, 30860, 30877

2910 Conservation

REFER ALSO TO CITATION(S) 30712, 30725, 30726, 30760, 30768, 30787, 30788, 30790, 30791, 30792, 30793, 30794, 30800, 30804, 30805, 30807, 30808, 30814, 30820, 30821, 30853, 30864, 30879, 30883, 30889, 31508

30694 (CONF-790346—) Conservation: energy management by design. (BDM Corp., Vienna, VA (USA)). 1979. Contract AC01-77ET20368. 233p. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

Separate abstracts are prepared for 17 papers presented at the conference. One paper had appeared previously in the appropriate DOE data base. (MCW)

30695 (CONF-790346—, pp 18p, Paper 5) **Conservation: energy management by design. Keynote address.** Apodaca, J. 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

Energy conservation concepts are discussed. The first concept noted is that efficient use of energy saves money and resources for everyone and for the future; the second concept notes that decisions for priorities in energy use must be jointly understood and made by the producer and consumer. Three main reasons why overall energy consumption rates have not been reduced are discussed. These include: government decisions and utility practices have been slow in backing up voluntary actions with economic incentives; the plans, assistance, and incentives for energy conservation have been confined to a few sectors of the economy; and there has been a failure to set priorities of energy use and to match fuel souces with appropriate uses. It is concluded that conservation has to be sold before it reaches the consumer. (MCW)

30696 (DOE/CS/40004—T12) TRW technical progress report, February-July 1977. (TRW, Inc., McLean, VA (USA)). 1977. Contract AC03-77CS40004. 31p. NTIS, PC A03/MF A01.

Progress in a program for identifying methods and policies for improving the effiency of the end use of energy in the US is

reported. This program includes evaluation of current and future energy supplies and consumption, energy policy, analysis, and studies of thermal energy storage, fuel cells, potential production of methane from coal beds, and the efficiency of residential space heating equipment. (LCL)

30697 **(DOE/CS/69001—T2) Market factors feedback system of the pilot program of the Energy Extension Service.** (Ragan (James) Associates, Pacific Palisades, CA (USA)). Apr 1978. Contract AC03-77CS69001. 140p. NTIS, PC A07/MF A01.

The market factors feedback system of the pilot program of the Energy Extension Service are described. The description contains the plans of the 10 pilot EES states and the DOE for operating the system between December 1977 and March 1979. Chapter one contains the planned scope of the market factors feedback system during the pilot program: the target audiences, program services, likely topics of market factors feedback, and energy decision makers. Chapter two presents how the market factors feedback system will operate over the pilot program period. Chapter three summarizes the roles and functions of DOE/EXT in supporting state EES market factors feedback operations and in evaluating the program. There are three appendices. Appendix A contains the market factors feedback plans of the pilot EES states. Appendix B describes how DOE/EXT will work with national-level energy decision makers on market factors feedback received from state EESs. Appendix C is the design for the formal evaluation of the market factors feedback component of the pilot EES program. (MCW)

30698 **(P—102-80-008) California Energy Demand 1980 to 2000: revised forecast for consideration in the proceedings on the Third Biennial Report. Volume II. Detailed appendices.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Nov 1980. 551p. California Energy Commission, Sacramento, CA. Order Number DE81903659.

Data are presented on electric, natural gas demand forecasts for agriculture and industry. Residential and commercial sectors are also detailed. (PSB)

30699 **(TVA/OP/ECR—81-19) Program summary.** (Tennessee Valley Authority, Chattanooga (USA). Office of Power). Apr 1981. 45p. NTIS, PC A03/MF A01.

The Tennessee Valley Authority has initiated energy conservation programs aimed at eliminating waste and to help consumers hold their overall energy use to the amount that is actually needed. An overview, features, status, and cost are discussed for research and demonstration programs and programs that have been implemented in energy conservation and management, solar applications, load management, and dispersed power production. (MCW)

30700 **Uncertainty: an argument for more stringent energy conservation.** Craig, P.P.; Levine, M.D.; Mass, J. (Univ. of California, Davis). *Energy (Oxford) ;* 5: No. 10, 1073-1083(Oct 1980).

This paper approaches the uncertainty problem in a simple way, nevertheless one that provides considerable insight. The authors assume that future energy-price growth is characterized by a probability distribution, and calculate the optimal investment strategy for conservation investment given this uncertainty. The results are striking. Introduction of uncertainty leads to the conclusion that more conservation investment is desirable than would be made without uncertainty. The conclusion stems, in essence, from the observation that the upside risk to the consumer resulting from unexpectedly high energy prices is larger than the downside savings which would result from unexpectedly low energy prices. The authors argue that the essential results cannot be captured simply by carrying out sensitivity analyses on deterministic models. 4 refs.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 29947, 30696, 30714, 30721, 30727, 30845

30701 **(AD-A—091569) Army energy plan.** (Deputy Chief of Staff for Logistics (Army), Washington, DC (USA)). 8 Aug 1980. 189p. NTIS, PC A09/MF A01.

The Army Energy Plan describes the current and projected (to the year 2000) energy situation in which the Department of the Army (DA) must operate and summarizes those actions and programs which have been developed and/or are needed to cope with those conditions. It addresses the Army goals, objectives, policies, and programs for all Army activities. World industrial growth during the past century has been characterized and hastened by the widespread availability of inexpensive energy, primarily petroleum. The Arab oil embargo of 1973 served to drive home a number of points, key among them being that the world's principal oil consumers are not the major oil producers. The Middle East and Africa have an estimated 67 percent of the petroleum reserves while Western Europe and the Western Hemisphere have only 16 percent. By most estimates, these reserves are expected to be exhausted within the next 70 years. In the year following the 1973 oil embargo, prices for petroleum rose threefold, signaling the end of the cheap oil. In the decade of the seventies, the price of imported crude oil has risen from $1.80 per barrel to an exorbitant $30.00 per barrel. The combined threats of exhaustion and high cost mandate the use of alternate sources of energy. The distribution of alternate sources of recoverable oil, such as tar sands and oil shale, favor the Western Hemisphere, but economical recovery techniques have not been developed.

30702 **(ANL/CNSV-TM—70) Guidebook for analysis of state-level economic impacts of an energy shortfall.** Gunnison, F. (Argonne National Lab., IL (USA)). Jun 1981. Contract W-31-109-ENG-38. 177p. NTIS, PC A09/MF A01. Order Number DE81027033.

This guidebook is designed to assist state policymakers in estimating the economic impacts of an energy supply shortfall. The guidebook does not contain state specific information, but outlines general procedures that can be tailored to specific state needs. Chapter 1 provides a user's guide to the book as well as cautions concerning its use and potential accuracy. The second chapter describes one general procedure for analyzing the possible economic impacts of an energy supply shortfall. The third chapter provides specific guidelines for constructing a simple model or first-order approximation of some of the immediate economic impacts of an energy supply shortfall. Chapter 4 examines several different petroleum supply shortfall scenarios comparing a base case with a 7% shortfall and a 14% shortfall. Then the analysis compares a shortfall affecting all sectors of the economy with one affecting private transportation alone. Thirdly, the chapter studies a shortfall affecting one state more severely than the rest of the nation. Each of those scenarios considers first-year and longer-term impacts. Finally, Chapter 4 analyzes the impact of restricting natural gas hookups for residential customers. The appendices provide further information on data sources, a survey of state-level models, and a detailed description of the state-level econometric model.

30703 **(PB—81-122277) LORENDAS model documentation. Volume 3. Computer-based system design and operation (LORENDAS project modeling of long-range energy development and supplies).** Rapoport, L.A.; Rohrer, M.W. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Apr 1978. 60p. NTIS, PC A04/MF A01.

The analysis of a complex set of technical, economic and political interactions is necessary in attempting to define the implications of any given policy or technological alternative concerning energy developments or supplies. The need for analyzing these interactions between a multitude of variables motivated the development of a comprehensive mathematical modeling system, in linear-programming format, of the worldwide Long-Range Energy Development and Supplies, referred to as the LORENDAS System. This computer-based system serves essentially to stimulate all the different operations and processes concerning the supply of energy, accounting for their technical and geographical interdependence and, also, their evolution through time. The present Prototype I version of the system encompasses the combination of the United States, Western Europe, and the principal oil exporting nations. Volume three presents in detail the design characteristics of the computer programs constituting the system and instructions for its operation. The complete listing of the model variables and equations and the corresponding mnemonics structure also are included.

30704 **Energy in a finite world: executive summary.** McDonald, A. Laxenburg, Austria; International Institute for Applied Systems Analysis (1981). 68p.

Report by the Energy Systems Program Group of the International Institute for Applied Systems Analysis; Wolf Haefele, Program Leader.

This report summarizes the results of a seven-year study conducted at IIASA in Laxenburg, Austria. The work, which involved over 140 scientists from 20 countries, aimed to provide new and critical insights into the international long-term dimensions of the energy problem. Given this objective, the 50-year period from 1980 to 2030 was analyzed in detail, though parts of the study looked even further into the future. Geographically, all countries of the world were included - developed and developing, market and centrally planned economies. The results are described in Energy in a Finite World: Paths to a Sustainable Future published in 1981 by the Ballinger Publishing Company, Cambridge, Massachusetts, USA; more detail is provided in a second volume also from Ballinger - Energy in a Finite World: A Global Systems Analysis. The picture that emerges is one of a world facing, during the 1980 to 2030 period, what is anticipated to be the steepest ever increase in its population. Despite the resultant strains on the world's physical resources, institutions, etc., it is concluded that the potential exists to provide the energy for a world in 2030 that is more prosperous than the world of today while supporting a population double that of 1975.

30705 **Energy in a finite world: a global systems analysis.** Haefele, W. Cambridge, MA; Ballinger Publishing Company (1981). 837p.

Report by the Energy Systems Program Group of the International Institute for Applied Systems Analysis.

This study, which began in the summer of 1973, focused for the first two years on understanding and conceptualizing the energy problem. This led to the design of a set of energy models that were subsequently used for developing two scenarios - the principal tool of the quantitative analysis. This book, which was completed in December 1979, reflects work up to this date. The purpose of this book is not to advance the state of the art of a particular discipline, but to look at each of the different aspects of the energy problem in a new way - to view them as an integral part of an overall pattern. The book is divided into 6 parts and a total of 25 chapters. Part I, Introduction, states the problem. Part II, Energy Supply, contains a total of 6 chapters, namely: Fossil-Energy Resources; The Coal Option; The Nuclear Option; The Solar Option; Renewable Energy Sources; and A Review of Energy-System Considerations. Part III, Constraints, contains chapters entitled: Market Penetration; The WELMM Approach to Energy and Natural Resources; Energy and Climate; Risks and Standards in Energy Systems; and Constraints on Energy Supply: The Summary. In Part IV, Balancing Supply and Demand, chapters included are: The Analytical Approach; Two Scenarios Defined; Interpretation of Scenario Projections; Energy Consumption and Conservation; Energy Supply and Conversion; Alternatives and Sensitivities; Economic Impacts; and Summary. In Part V, Perspectives, the chapters are: Energy, Negentropy, and Endowments; New Old Technologies; Energy Densities, Land Use, and Settlement Patterns; and The Hard-Soft Controversy. Part VI, Assessments and Implications, has only one chapter, The Problem Revisited, and was written by the Program Leader, Dr. Wolf Haefele.

30706 **Fuel choice and aggregate energy demand in the residential and commercial sectors.** Cohn, S.M. (Oak Ridge National Lab., Tenn). *Energy (Oxford) ;* **5**: No. 12, 1203-1212(Dec 1980).

The energy demand response of the residential and commercial sectors to fuel price changes is of increasing importance to public policy makers. In this paper, the demands for energy in both sectors are examined separately using a refined data base. For each sector, a multinomial logit formulation is utilized, along with an aggregate demand equation to determine analytically short- and long-run fuel-price elasticities of demand for the major fuels consumed. It is found that increases in energy prices have a greater effect on energy demand in the commercial sector. Furthermore, in both sectors, raising electricity prices has a greater effect for conserving energy (both end-use and primary) than do equal price rises for natural gas or heating oils. 18 refs.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 30681, 30682, 30696, 30717, 30723, 30759, 30766

30707 **(DOE/EV/74010—T1) National Coal Utilization Assessment: project plan.** (Aerospace Corp., Germantown, MD (USA)). Dec 1976. Contract AT03-76EV74010. 31p. NTIS, PC A03/MF A01. Order Number DE81026725.

ERDA is sponsoring a project entitled the National Coal Utilization Assessment. This document, the project plan for this assessment, contains an identification of the principal users and uses which represent the focus of the effort, a description of the requirements, strategies and methods of the project implementation, and its schedule of performance. The Administrator for Environment and Safety (AES) has in place six national scientific laboratories currently engaged in regional assessment programs covering the entire United States. With this resource and the defined need for the data and analysis from a coordinated assessment program for its management effort, AES has decided to initiate this assessment. Possible strategies include: the present RD and D and new research, siting patterns, interagency coordinations, planning guidelines, regulatory programs, monitoring options, and financial/growth management options. The implementation strategy of this project is to assess the impacts of increased coal utilization in the US, including the relative impacts and consequences of alternative coal technology options as functions of the level and geographic distribution of use from the present to the year 2020. This data, together with special assessments generic to environmental issues or to the technology, will be combined to: identify the principal health, safety and other social concerns, and the environmental constraints to the increased use of coal; clarify the options available to federal and state decision makers which could mitigate the issues or resolve the problems; and analyze the environmental consequences which would result from the selection of these options. This assessment is designed to meet the needs of three principal users: ERDA, state and regional agencies, and industry.

30708 **(PB—81-118028) New York State energy master plan and long-range electric and gas report. Volume 1. Executive summary. Final report.** (New York Energy Office, Albany (USA)). Mar 1980. 41p. NTIS, PC A03/MF A01.

Partial listing of topic areas include: Scope and impact of planning process; Structure of master plan; State energy policies; Current and forecast energy requirements; Reshaping the state's energy future; Schedule for planning process.

30709 **(PB—81-118036) New York State energy master plan and long-range electric and gas report. Volume 2. Appendices. Final report.** (New York Energy Office, Albany (USA)). Mar 1980. 165p. NTIS, PC A08/MF A01.

A partial listing of contents includes: Summary of the plans of major energy suppliers; Forecast of New York state energy requirements; Economic impact analysis.

30710 **(PB—81-118044) New York State energy master plan and long-range electric and gas report. Volume 3. Final report.** (New York Energy Office, Albany (USA)). Mar 1980. 219p. NTIS, PC A10/MF A01.

A partial listing of contents includes: Policy context; New York state energy-use energy requirements, base case; Plan elements--overview; Conservation; Research and development plan; Energy financing--Institutional changes; Impact of rising energy costs on low income households; Long-range electric and gas report.

30711 **Congress and national energy policy: assessing the policymaking process.** Kraft, M.E. (Univ. of Wisconsin, Green Bay). pp 37-59 of Environment, energy, public policy: toward a rational future. Axelrod, R.S. (ed.). Lexington, MA; D.C. Heath and Company (1981).

From Conference on energy and environment; Garden City, NY, USA (8 Jun 1979).

On July 15, 1979, President Jimmy Carter took his case for a rational energy policy to the American public. During 1977 and 1978, the US Congress deliberated on President Carter's national

energy plan. Although the plan was comprehensive and national, Congress rejected its key elements. This chapter surveys the policy-making process in Congress and the various possible reasons for the failure of the plan. Although an optimistic attitude for the development of public support for a national energy future in US may be justified, perhaps a position of hopeful pessimism may be adopted. 46 references. (DLC)

30712 **Role of local government in energy policy.** Harrison, D. Jr.; Shapiro, M.H. (Harvard Univ., Cambridge, MA). pp 131-152 of Environment, energy, public policy: toward a rational future. Axelrod, R.S. (ed.). Lexington, MA; D.C. Heath and Company (1981).

From Conference on energy and environment; Garden City, NY, USA (8 Jun 1979).

Local governments may play a role in enrgy conservation by reducing energy consumption in operating public buildings and by encouraging private citizens to reduce energy consumption. Such a role is generally small, although local circumstances affect the effectiveness of federal and state programs. 27 references, 3 figures, 5 tables. (DLC)

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 29931, 29932, 29946, 29949, 29950, 29951, 29952, 29953, 29954, 29958, 30672, 30675, 30676, 30685, 30698, 30707

30713 **(LA—8936) Tar sand: a petroleum resource of the future.** Aamodt, P.L.; Freiwald, J.G. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01. Order Number DE81028379.

Tar sand deposits that are 7% bitumin by weight, more than 10m thick, and less than 50m below the Earth's surface now have potential for near-term development. The amount of recoverable crude oil in US deposits could offset US petroleum imports for about 10 to 15 years. A comprehensive program is needed to define the areas and characteristics of US deposits and to develop new efficient and economical methods of in situ recovery, including thermal and nonthermal mobilization and combinations of conventional and novel extraction techniques.

30714 **(P—150-81-001) Administration of the state fuels set-aside. Annual report to the Legislature.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Jan 1981. 84p. California Energy Commission, Sacramento, CA. Order Number DE81903672.

In response to the oil embargo of 1973-74, the United State Congress passed, and the President signed into law, the Emergency Petroleum Allocation Act of 1973, PL 93-159. This law gave broad fuel regulation powers to the predecessor of the United States Department of Energy and allowed limited delegation of administrative authority to the states. During the embargo, California accepted the federal delegation to establish and operate a state gasoline set-aside. The set-aside allows state government to allocate a limited amount of fuel directly to users experiencing a hardship or emergency caused by a fuel shortage. Originally the responsibility of the California Department of Conservation's Division of Oil and Gas, in 1974-75 the program was transferred to the Resources Agency. After the effects of the embargo dissipated, the gasoline set-aside was not extensively used again until early 1979. This report is a detailed discussion of the Commission's administration of the state set-aside between March 1979 and January 1981. In light of pending fuel shortages, in March and April 1979 the Governor and the Energy Commission reactivated the gasoline set-aside and established a diesel set-aside. During the most recent 1979-80 shortage, the diesel set-aside was the most heavily used. It was exhausted in July, August, and September of 1979. A comparable number of gallons were allocated from gasoline set-aside, but it is over five times the size of the diesel set-aside, and thus was never depleted. The Commission has received very few applications for propane set-aside. The majority of set-aside recipients are in the agricultural industry. More than half of all diesel and one-quarter of all gasoline gallonage went to this sector. Many nonagricultural industry groups also apply for and receive set-aside. The construction industry, for example, is the largest second priority class. (DMC)

30715 **Will oil imports be available: and at what price.** Rustow, D.A. (City Univ. of New York, NY). pp 9-14 of Environment, energy, public policy: toward a rational future. Axelrod, R.S. (ed.). Lexington, MA; D.C. Heath and Company (1981).

From Conference on energy and environment; Garden City, NY, USA (8 Jun 1979).

The author first attempts to dispel some of the myths that sprang up during the energy crises in 1973-1974 and 1979-1980. OPEC has been the price setter not only for the global oil market but also (to some extent) for energy in general. The true problem is that there is an oligopolistic structure in the world energy market in which OPEC, non-OPEC oil exporters, the oil companies, coal and uranium producers, and the patent holders on shale-retorting and coal-liquefaction processes all participate. The author says the solution lies in smaller cars. (DLC)

30716 **International business conference: world energy outlook.** Saint Louis, MO; Saint Louis University (1979). 89p. (CONF-7911141—).

From International business conference on world energy outlook; St Louis, MO, USA (16 Nov 1979).

Proceedings of the meeting are published in this volume. Representatives of the USA, Kuwait, the European Community, oil industry, coal industry, government, and academia presented papers at the conference. Separate abstracts have been prepared for items within the scope of the Energy Data Base. (DMC)

30717 **OPEC: present and future responsibility.** Jaffar, K.M. pp 2-9 of International business conference: world energy outlook. Saint Louis, MO; Saint Louis University (1979).

From International business conference on world energy outlook; St Louis, MO, USA (16 Nov 1979).

This article contains the text of the address given by the Kuwait Ambassador to the USA. It was pointed out that increasing oil prices alerted the people of the world to the depletable nature of oil. At the same time higher oil prices not only brought about a new awareness of the need for energy conservation, but also helped to expedite development of alternative energy sources. The price of oil was unjustly frozen at a very low level for twenty years while prices of other commodities were escalating. He also argued that the present high oil prices were prolonging the life span of oil in order to cushion the transfer period to lternative energy sources, and to build a new economic base for OPEC countries in the post-oil era.

30718 **Washington legislative outlook on energy.** Eagleton, T.F. pp 11-16 of International business conference: world energy outlook. Saint Louis, MO; Saint Louis University (1979).

From International business conference on world energy outlook; St Louis, MO, USA (16 Nov 1979).

Senator Eagleton told the conference that the most traumatic effect of the new energy reality could be seen in the country's industrial base. He cited that because of higher prices of oil, Ford Motor Company's North American operations lost $1 billion in 1979 and other automobile manufacturers laid off many workers throughout the country. He also mentioned that contrary to some critics, the windfall profit tax would not encourage oil companies to explore new production efforts, because the level of their profits are already high enough.

30719 **Coal's participation in world energy supplies.** Quenon, R.H. pp 18-31 of International business conference: world energy outlook. Saint Louis, MO; Saint Louis University (1979).

From International business conference on world energy outlook; St Louis, MO, USA (16 Nov 1979).

A brief summary of the current world energy situation is presented. The author forecasts that the decade of the 80's will see a continuation of growth in oil consumption. Although coal should play a much larger role as an alternative source of energy, coal production has been constrained by government regulation so that the US coal industry has been producing below capacity. Even accounting for expensive scrubbers to control air pollution, it would

be much cheaper not only for new power plants but also for existing oil-fired power plants to switch to coal rather than oil or gas. The importance of coal to the world's future energy supply is discussed. (DMC)

30720 **Energy and the future: a corssroads for the world.** McAfee, J. pp 35-44 of International business conference: world energy outlook. Saint Louis, MO; Saint Louis University (1979).

From International business conference on world energy outlook; St Louis, MO, USA (16 Nov 1979).

Gulf Oil's view of the global and US energy situation is presented by a representative of that corporation. Three points are addressed: the present situation, the President's Actions, and the long-term solution. The author called for a global economic conference between oil-producting and oil-consuming countries in order to resolve the chaotic energy supply situation. He indicated that a solution to the world energy problem can be arrived at only by consultation and negotiation, not by unilateral action. He further indicated that the issue can be faced only by recognizing the global nature of economic and energy interdependence. It was pointed out that if OPEC embargoes or cuts back its production substantially, it could plunge the developed countries as well as the rest of the world into depression and chaos. This in turn would result in a loss of OPEC earnings, imperil their investments and set back their opportunities for development.

30721 **MIT world oil project outlook.** Paddock, J.L. pp 46-61 of International business conference: world energy outlook. Saint Louis, MO; Saint Louis University (1979).

From International business conference on world energy outlook; St Louis, MO, USA (16 Nov 1979).

A statistical model which forecasts world oil markets and gives international perspectives is discussed. It separates consumer countries from producing countries and also separates the various sectors within the countries that use the energy. According to the MIT statistical model of world oil supply and demand, price should gradually clear the market. However, in reality oil prices are expected to follow an upward ratchetting pattern over time. The model focuses on the net demand on OPEC, and its impact on the price and GNP growth rate. The author's conclusion is that the Western countries will continue to depend on OPEC oil for the foreseeable future in spite of new supplies of alternative energy sources.

30722 **American petroleum problems and the future outlook.** O'Keefe, W.F. pp 63-70 of International business conference: world energy outlook. Saint Louis, MO; Saint Louis University (1979).

From International business conference on world energy outlook; St Louis, MO, USA (16 Nov 1979).

The overall energy problems faced by the nation and the country's energy future are briefly addressed in this presentation. Discussed are: the current energy situation; divisions; reasons for our energy dilemma; energy illusions; the 1980's - a crossroad; future energy sources; energy planning; and reliance on the price system. The author mentioned that despite the recent oil embargo, the US has increased its dependency on imported oil and has not been successful in energy conservation efforts. He believes that the decision to decontrol crude oil was a major step in the right direction to increase the supply of oil production and investments in the related fields.

30723 **European view of energy problems.** Goppel, M. pp 72-77 of International business conference: world energy outlook. Saint Louis, MO; Saint Louis University (1979).

From International business conference on world energy outlook; St Louis, MO, USA (16 Nov 1979).

The European view of the energy problem is presented in this article. Europe is dependent upon imported energy, particularly oil. Natural gas resources are limited and without new discoveries, production will soon peak. The stability of energy supplies is thus exposed to foreign events. To address problems in the world energy market, the European countries have limited their oil imports to the 1978 level of 9.4 million barrels a day. Resource development in other areas, particularly coal, is being undertaken. The author suggests that the energy issue, being a common problem, should result in solidarity between industrialized countries in order to solve the problems and ensure the future of humanity. (DMC)

2950 Hydrogen And Synthetic Fuels

30724 (SERI/CP—633-1145, pp 33-37) **Research and advanced development sunfuels program.** Corona, F. (Dept. of Energy, San Francisco, CA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

A programmatic overview of the program is presented. The ultimate goal of the program is to develop and implement technology that utilizes fuels and chemical processes integrated with solar thermal technologies that will affect the production of transportable fuels, industrial feedstocks, and chemicals by 1990. Intermediate objectives of the program and program strategies are outlined. The program activities and planning schedule are given. (LEW)

2960 Electric Power

REFER ALSO TO CITATION(S) 30113, 30114, 30116, 30551, 30672, 30674, 30677, 30695, 30698, 30771

30725 (CONF-790346—, pp 34p, Paper 1) **Energy management benefits through the consumer/utility interface.** Peck, D. (Public Service Company of New Mexico, Albuquerque); Schilling, J. 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

The traditional customer/utility relationship is examined by depicting the major communication channels from the customer to the utility and from the utility to the customer. Illustrations of Public Service Company of New Mexico's and Arizona Public Service Company's average system profiles during the summer of 1978 are presented to compare their differing seasonal demand relationships. Trade-offs between first costs or fixed costs and operating costs or variable costs are discussed. Four test descriptions at APS briefly discussed are a residential time-of-day experiment, a supervisory load control experiment, air conditioning waste heat for hot water, and a demand reduction program. Four research programs at PNM briefly discussed are a solar water heating experiment; construction of 25 solar/load managed homes (HUB cycle 3 grant); construction of 5 SHAC demonstration homes; and a passive solar home project. (MCW)

30726 (CONF-790346—, pp 14p, Paper 2) **Conservation: energy management by whose design and at what cost.** Wall, E.R. 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

The role of energy planning and involvement is discussed at three levels: government, the utility industry, and the consumers. Legislative measures adopted in the 1970's dealing with public utilities are discussed. Potential partial relief from some of this expensive, regulatory overkill is briefly discussed. Legislation dealing with conservation is noted and a brief analysis of its impacts is made. Public perceptions of energy matters are discussed. (MCW)

30727 (CONF-790346—, pp 11p, Paper 3) **Strategic planning for an electric utility in an era of uncertainty and capital constraints.** De Simone, L.E. (San Diego Gas and Electric Co., CA). 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

The electric utility planning process from a historical perspective is reviewed by identifying how planning has been done, how it is changing, and how it will be conducted in the future. Emphasis is placed on factors which have necessitated a change in the last five years. (MCW)

30728 (DOE/CE—0007) Power and transmission-rate orders and related documents. Office of power marketing coordination: data compiled through December 1979. (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). Jul 1981. 145p. NTIS, PC A07/MF A01. Order Number DE81026903.

Prior to the establishment of the Department of Energy, power from Federal projects was marketed by five power marketing agencies under the Department of the Interior. These were the Alaska Power Administration (APA), the Bonneville Power Administration (BPA), the Southeastern Power Administration(SEPA), the Southwestern Power Administration (SWPA), and the United States Bureau of Reclamation(USBR). Under the ratemaking process, in effect prior to the establishment of DOE, the rates and charges for electric power by the then four power administrations were prepared by the individual Administrators subject to confirmation and approval by the FPC. The rates and charges for electric power marketed by the USBR, were subject to final approval of the Secretary of the Interior. In 1977 the Secretary of Energy authorized the Economic Regulatory Administration (ERA) to confirm and approve all Federal power rate adjustments proposed by the five power administrations, and in December 1978 the Secretary of Energy, signed Delegation Order No. 0204-33 which delegated to the Assistant Secretary for Resource Applications the authority to confirm, approve, and place in effect power and transmission rates on an interim basis and delegated to the FERC the authority to confirm and approve such rates on a final basis. The delegation order became effective January 1, 1979. This publication is a compilation of all rate orders issued by the Assistant Secretary for Resource Applications during Calendar Year 1979 under that delegation order. It also includes all final confirmations and approvals by the ERA and the FERC from October 1, 1977, through December 31, 1979. For ready reference, also included are all delegation orders and departmental orders relating to Federal power marketing.

30729 (DOE/EP/10004—1) Need for power and the choice of technologies: state decisions on electric power facilities. (American Bar Association, Washington, DC). Jun 1981. Contract AC01-79RG10004. 221p. NTIS, PC A10/MF A01. Order Number DE81025960.

The findings and recommendations are presented of a study conducted by the American Bar Association's (ABA) Special Committee on Energy Law (SC) to assess decision-making processes at the state level regarding the licensing of electric generating facilities. The basic issues addressed in this report are the need for power and choice of technology: state decisions which directly influence and affect the nation's energy supply, and the tradeoffs involved in meeting energy demand. The areas of special emphasis included the legal mechanisms and regulatory procedures used to determine and resolve these issues. The effectiveness of state decision-making was assessed, focusing on legal and administrative histories and accommodation of interests of concerned parties. Recent innovations to enhance the decision-making process were also assessed where applicable. No particular substantive results are advocated in the findings. The recommendations are broad in scope and include: to the greatest extent feasible, an appropriate state agency should determine the need for power and choice of technology in regular generic proceedings open for public participation; to complement the open planning process, states should require a fair, timely and dispositive certification process to judge the conformity of proposed new facilities with an adopted advance plan; the responsibility for assessing and promoting energy conservation and less traditional sources of power should be vested in the same authority which plans and certifies new facilities; states should continue to experiment with ways to identify and incorporate multi-state, regional, and national concerns in their planning for energy needs and in the construction of new energy facilities; and steps should be taken, e.g., the free flow of information among all participants, to assure basic procedural fairness without losing sight of the goal of reaching and enforcing decisions. (LCL)

30730 (DOE/RG/06666—T1) Future powerplant availability: improvement study. Final report. Hartnett, J.P. (Illinois Commerce Commission, Springfield (USA)). 1979. Contract AC01-78RG06666. 228p. NTIS, PC A11/MF A01. Order Number DE81027289.

This project consists of four tasks. The objective of Task I is to document and assess current Illinois Commerce Commission and utility practices concerning reliability planning for future units, and to identify and explain existing incentives and/or disincentives to the attainment of highly reliable new units. The Task II objective is to identify and analyze a number of candidate actions which the Illinois Commerce Commission could implement without a major overhaul of current policies, but which would have a definite, positive effect on the reliability of future generating units. The Task III objective is to develop candidate regulatory policies, procedures, and practices which will promote cost-effective levels of reliability for future generating units. The Task IV objective is to provide information to the extent possible regarding the general range of reliability available for new generating units above 200 MWe and the cost-tradeoffs associated with various levels of reliability. Task IV has as an additional objective to provide information regarding the potential impact of various future unit reliability levels on the State of Illinois in terms of capacity deferral, scarce fuel displacement, ratepayers and utilities. The results of this study indicate that reliability needs to be given great consideration in the certification of new power plants, that working with past performance data standardized, design criteria can be developed which will enhance plant availability, and that there are demonstratable economic incentives for minimizing unanticipated forced outages. (LCL)

30731 (DOE/RG/08073—T1Vol.1) Los Angeles electricity rate study. Final report. Acton, J.P.; Mitchell, B.M. (Los Angeles City Dept. of Water and Power, CA (USA); RAND Corp., Santa Monica, CA (USA)). 1980. Contract FC01-75RG08073. 676p. NTIS, PC A99/MF A01. Order Number DE81027827.

This volume contains the following reports (with their publication dates noted): Design of the Los Angeles Peak-Load Pricing Experiment for Electricity, November 1974; Peak-Load Pricing in Selected European Electric Utilities, July 1977; Lessons to be learned from the Los Angeles Rate Experiment in Electricity, July 1978; Conducting a Survey Using the Client's Staff - Evaluation of Interviewer Performance in the Electricity Rate Study, September 1979; The Los Angeles Senior Citizen Lifeline Electricity Rate, January 1979; Seasonal Electricity Demand and Pricing Analysis with a Variable Response Model, May 1980; Residential Electricity Demand under Time-of-Day Pricing - Exploratory Data Analysis from the Los Angeles Study, December 1980; Sample Selection in the Los Angeles Electric Rate Study, July 1979; British Industrial Response to Peak-Load Pricing of Electricity, February 1980; and Evaluating Time-of-Day Electricity Rates for Residential Customers, November 1979. (LCL)

30732 (DOE/RG/08073—T1(Vol.2)) Do time-of-use rates change load curves. (RAND Corp., Santa Monica, CA (USA)). May 1980. Contract FC01-75RG08073. 426p. NTIS, PC A19/MF A01. Order Number DE81027842.

This volume contains the following reports (with their publication dates noted): Do Time-of-Use Rates Change Load Curves, May '80; Electricity Consumption by Time of Use in a Hybrid Demand System, Dec. '80; The Effects of Time-of-Use Rates in the Los Angeles Electricity Study, Oct. '80; Planning, Processing, and Analyzing Data for Residential Load Studies, June '80; The Move Towad Marginal Cost Pricing in Electricity, June '76; Selected Econometric Studies of the Demand for Electricity, No. '75; Economic Principles and the Structure of Electric Rates - Cost of Service, Allocation of Costs, and Rate Design, Nov. '75; Economic Modelling of Peak Electricity Demands, April '77; Electricity Ratemaking - an Overview, May '77; Curtailment Ordinances as an Approach to Electricity Shortages, Sept. '77; Charging Up for Electric Rate Reform, Nov. '77; and Electricity Prices and the Poor - What are the Effects and What Can We Do?, Mar. '80. (LCL)

30733 (DOE/SF/01182—T6) Bases for the main thrusts in electric energy systems. (TRW, Inc., McLean, VA (USA)). 3 Dec 1976. Contract AM03-76SF01182. 13p. NTIS, PC A02/MF A01. Order Number DE81024197.

Past electric power generation and transmission methods used in the US to meet power demand, and future power system requirements to meet the needs of more power, produced from available energy sources and delivered at the least economic and

environmental cost are discssed. Ways in which the electric utilities can meet future requirements, i.e., improved generation technology, including dual-purpose power plants, dispersed generation and storage, and new conversion cycles using solar, wind and geothermal sources, and improved transmission and distribution systems are described. Four programs for insuring that the US electric energy system meet future demands in a reliable, efficient and environmentally accepted manner are proposed. (LCL)

30734 (NP—22596) **Electric-Utility Rate-Design Study: proceedings of the rate-design-study regional conferences.** (Resource Planning Associates, Inc., San Francisco, CA (USA)). 21 Oct 1980. 556p. (CONF-8005161—). EPRI, Palo Alto, CA. Order Number DE81901974.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

The initial paper, Introduction/Framework, to the conferences is presented by Leigh Hammond, North Carolina Utilities Commission. Papers by William Jefferson, Gulf State Utilities Company and Rene Males, Electric Power Research Institute, contain concluding comments. A separate abstract was prepared for each of the other 26 papers. (MCW)

30735 (NP—22596, pp 11-32) **Cost and rates.** Malko, J.R. (Electric Power and Research Inst., Palo Alto, CA). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Matters concerning costing and rate design for electricity (The Great Rate Debate) are discussed. The impacts of the Debate on these issues are noted. An attempt is made to develop a framework that will define various issues in order to provide information for regulators of utilities to gain some better understanding of complex costs and rate problems. A structure for examining pricing by objectives provided by Dr. James Bonright and the aims of PURPA are discussed. Time-of-use and non-time-of-use pricing, marginal-costing, and accounting costs are discussed. Major findings from the Rate Design Study are noted. It is concluded that alternative accounting and marginal cost methods that have been developed and applied address or satisfy, in varying degrees, alternative-pricing objectives. (MCW)

30736 (NP—22596, pp 33-69) **Cost-based rates.** Palmer, H. 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Time-differentiated accounting costs as a basis for time-of-use rates are discussed. Four methods that allocate energy-related costs in the same way are described. The first demand allocation method is called Probability of Contribution to Peak, developed by Dr. Howard Pifer. The thought there is that all demand costs should be charged to the peak-system demand and doled out in proportion to each customer's contribution to that peak. The EBASCO method is strictly a supply-side method. It tends to break down the demand-related costs of the system into three main categories - base plant, intermediate plant, and peak plant (BIP). The method developed by C.T. Main is a sophistication of the BIP method and is called Fuel Availability Dispatch. In this method, the capacity cost of each unit is distributed over the year in a progressive allocation, first to months, then to days of the month, and finally to hours of the day. The Ernst and Whinney method called Recontracting for Capacity distributes each plant's fixed cost, based on the premise that the utility's customers may bid for or contract for the amount of capacity that they need throughout the year. This concept simulates the conditions that would exist in a free and competitive market which could set prices, determine output levels, and provide a normal return for equity holders. (MCW)

30737 (NP—22596, pp 71-92) **Cost and rates: marginal cost.** Tennican, M. 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Rate design is discussed with emphasis on time-of-use pricing. Situational factors are described to show their importance in determining whether to use time-differentiated or non-time-differentiated rates. Comments are made on time-differentiated accounting costs that provide perspective for some subsequent comments on time-differentiated marginal-cost methods. Some differences in the available major marginal-costing methodologies are pointed out. The methodologies of Ernst and Whinney; Cicchetti; Gillen, and Snolensky; Gordian Associates; and the National Economic Research Associates are examined. It is concluded that, despite difficulties, both time-differentiated accounting cost and time-differentiated marginal-cost methods are practicable for rate making. (MCW)

30738 (NP—22596, pp 93-115) **Cost and rates.** Uhler, R.G. 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

In a discussion on the historical perspective of rate design, the contribution made by Leland Olds, a Commissioner at the Federal Power Commission at the time of President Roosevelt is described. Pricing by objectives is discussed in detail and conservation is deemed most important today. Cost-based rates (customer and utility acceptance, capacity and energy-cost trends, cost-based rated for load controls) are discussed. Costs varying by time of use and alternative-costing methods are discussed. Recommendations made are: that a course of action be chosen; adopt TOD rates selectively; sequentially monitor progress; make cost-benefit calculations prospectively; continually monitor the results of load management; and do the cost-benefit calculations over and over. (MCW)

30739 (NP—22596, pp 117-131) **Load research.** Fitzpatrick, G.L. 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Load-research technicalities are presented in a nontechnical way. The reasons load research need be conducted and why load research must be performed are covered. Kinds of costs incurred by all the aspects of a load-research program are described. The transferrability of load-research information is discussed, and insights and guidance are offered. (MCW)

30740 (NP—22596, pp 133-146) **Load research.** Whitney, D. (Los Angeles Dept. of Water and Power, CA). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

The traditional load research program at the Los Angeles Dept. of Water and Power, aimed at gathering the cost-of-service data necessary to design rates, is discussed. Then nontraditional load research is discussed, which is the measure of elasticities and customers' responsiveness. The need for additional load research, problems with future load research, and special problems for small utilities are discussed. Slides were used throughout the speech. (MCW)

30741 (NP—22596, pp 147-166) **Load research.** Abdoo, R.A. (Wisconsin Electric Power Co., Milwaukee). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

The experiences with load research at Wisconsin Electric Power Company are reviewed, and a schematic of the program is shown on a slide. Planning, equipment, reliability, commitment, software, and flexibility are presented as parts of a successful load-research program. Emphasis is placed on planning as being the most-important aspect, and this item is discussed at length. Mr. Abdoo's opinion is that load research is a misnomer; that you are actually talking about a massive data collection, correction, and maintenance operation - as witness Wisconsin Electric's 1000 meters installed with 4 data points per hour.

30742 (NP—22596, pp 167-188) **Load research.** Leo, J. (Middle South Services, Inc., New Orleans, LA). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Measures for a successful load-research program are noted. Some important uses for load research are outlined, and a case history of how Middle South Services, Inc. plans to utilize load-research data is given. The requirements established by PURPA are briefly discussed. (MCW)

30743 (NP—22596, pp 189-205) **Equipment for load management.** Schaefer, J. 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Equipment used for load management is described. Options feasible for load management pointed out are remote control of loads (water heaters, air conditioners, irrigation pumps, space heaters, etc.); local control of loads (interlocks, clock timing); and time-of-use rates. Equipment needed to implement these options and experiences with the equipment are discussed. Costs of the equipment and evaluation methods for load-management options are detailed. (MCW)

30744 (NP—22596, pp 207-232) **Load control.** Hart, P. (Arizona Public Service Co., Phoenix). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

The on-site load-control experiences at Arizona Public Service Company are discussed. Details of a proof of concept test to search for a viable controller more sophisticated than a simple interlock and to determine the results of having the controller function on demand at any time, as opposed to a timing limitation, are described. The proof of concept test continues with time-of-day demand/energy rates, with and without on-site controllers involving about 240 customers. Information developed to date is discussed and some lessons learned are noted. (MCW)

30745 (NP—22596, pp 233-254) **Load control at Detroit Edison.** McIntyre, R.L. (Detroit Edison Co., MI). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Detroit Edison is engaging in many load-management programs. The controlled water-heating program is described in detail. The aim of the program started in 1934, was to minimize the impact of water-heating load on system peaks and to provide water-heating service to customers at the lowest possible price. Control devices considered over the years are mentioned, but radio control was installed. The interaction of the controlled water-heater system with air-conditioning control and the effects of both of these controls on the distribution system are discussed. Brief comments are made on the load-management system hardware presently in use. (MCW)

30746 (NP—22596, pp 255-274) **Load management and controls.** Browne, G.R. (New England Power Service Co., Westborough, MA). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Development of a plan called NEESPLAN at New England Power Service Company is described. The basic objective of NEESPLAN was to limit peak-demand growth to 1.9% with energy growth limited to 2.4% and to reduce reliance of foreign oil from today's 78% to 10% by 1995. One of the more-specific programs is an intensive load-management and conservation program which is addressed in the presentation. The relationship of load control to rate structure is examined. Predictions about load control are made. (MCW)

30747 (NP—22596, pp 275-288) **Customer attitudes.** Kuestler, D.A. (Elrick and Lavidge, Inc., San Francisco, CA). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

The importance of customer attitudes and opinions to utilities is discussed. Measurements of attitudes or understandings and acceptance are explained. Then, the author describes several types of customer surveys that Elrick and Lavidge has conducted for the Rate Design Study and for private clients including both investor-owned and public-power utiities. Acceptance of peak-load cycling of central air conditioners is discussed specifically. (MCW)

30748 (NP—22596, pp 289-316) **Time-of-use rate studies with residential customers.** Miedema, A.K. 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Research Triangle Institute (RTI) is involved in a North Carolina Rate Deminstration Project and an analysis of time-of-use rates for residential customers for all of the 16 residential-rate-demionstration projects sponsored by DOE. The essential background and objectives of the time-of-use rate-demonstration projects that were undertaken by DOE are described. RTI's role in analyzing data from the projects and the broad results that RTI has developed to date are described. Important factors that may affect the transferability of these results to other service areas are noted. Some critical factors affecting potential future designs of experiments - factors that may warrant consideration in responses to PURPA or in development of utility studies are mentioned. (MCW)

30749 (NP—22596, pp 317-339) **Customer response.** Reynolds, S.P. (Pacific Gas and Electric Co., San Francisco, CA). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Pacific Gas and Electric Company's experience with commercial and industrial time-of-use rates and the elasticity issues associated with those rates are discussed. Specifically, its marginal cost based, time-of-use average cost rate is reviewed. Its objectives and a measurement of the response that has been deduced from the impact of these particular rates are examined. These issues are then related to the Rate Design Study. Slides were used to illustrate the presentation. (MCW)

30750 (NP—22596, pp 341-349) **Load-management evaluation.** Plummer, J. (Electric Power Research Inst., Palo Alto, CA). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Integrative analysis in relationship to PURPA and to rate design or load management is discussed. Its implication to institutional meaning is noted and cost-benefit analysis results of the Rate Design Study are reviewed. The initiation of the Load Management Model project at EPRI, efforts to add demand-side detail (load management options) to existing supply-side optimizing models, and an optimization model for generation expansion (also at EPRI) are explained. (MCW)

30751 (NP—22596, pp 351-366) **Load-management application and evaluation.** Oatman, E. (Electric Power Research Inst., Palo Alto, CA). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

The presentation focused on the decision-making process and the role of cost-benefit analysis in developing cost-effective load-management programs. The interface between the customer and the utility is examined. Analytical tools available and some specifics of work performed during the Rate Design Study are discussed. Examples include: a method to evaluate the potential economic benefit of shifting load from on-peak to off-peak; a cost-benefit evaluation based on the use of a large linear-programming model; combinations of load-management options such as cycling of air conditioners, thermal storage with heat pumps, and solar-assisted heat pumps; and the effect of reserve margin and cost to consumers of shifting-peak loads. Insights and guidances of cost-benefit evaluation are examined. (MCW)

30752 (NP—22596, pp 367-393) **Load management.** Whyte, D. 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Load management is pointed out as being an integral part of the utility planning process and the specific program at Southern California Edison Company is discussed. Cost-effective calculations at California Edison and an evaluation of the load-management program are described. It is noted that load-management can be used to reduce cost to customers and is utility-specific. (MCW)

30753 (NP—22596, pp 395-414) **Load management.** Buden, L. (Dayton Power and Light Co., OH). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Load management as practiced at The Dayton Power and Light Company is discussed. The initial involvement with load management and the program at the utility are described. The planning and organizing processes necessary and problems encountered in implementation are discussed. The necessity of continuing review of the results of the program and of the environment is emphasized. Many charts are included in the presentation. (MCW)

30754 (NP—22596, pp 415-441) **Load management.** Berry, W.W. (Virginia Electric and Power Co., Richmond). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Virginia Electric and Power Company's approach to load management is reviewed, including its history. The direct load-management program, which involved direct control of electric water heaters, is discussed. Also discussed is the indirect load-management program, which centered on time-of-use rates for large residential customers. Results of an evaluation of the programs were used to develop several different load-management scenarios and to forecast the impact of implementing these scenarios on future growth rates. These modified forecasts for demand and energy were then used to develop future plant requirements. A load-shape model is currently being developed to assist in the forecasting. An evaluation of net cost and benefits of large-scale implementation is in progress to complete the cycle and the final step is to proceed to the regulatory review. (MCW)

30755 (NP—22596, pp 443-452) **Load-management evaluation.** Bryson, J.E. (California Public Utilities Commission, San Francisco). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Load management as view in California encompasses marginal-cost rate design, load cycling and other interruptible service, and a wide variety of utility- and customer-initiated conservation programs. These are summarized from a regulatory point of view. Time-of-use rates, load control and cycling equipment, marginal cost methodology electric rate structure reform, and load management through conservation are discussed. (MCW)

30756 (NP—22596, pp 453-470) **Load management.** Fischer, R.F. (Michigan Public Service Commission, Lansing). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

A review of electric utility load management programs is presented and the potential for incorporation of load control concepts into utility operating phiolosophy is explored. Additional discussion follows on what should and should not be done and how to do it. Specifically discussed are supply-management and load-management efforts in Michigan and purposes of load management. (MCW)

30757 (NP—22596, pp 471-498) **Load management.** Zielinski, C.A. (New York State Public Service Commission, Albany). 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

A brief description of load management as defined in New York is given. Regulatory goals are discussed which include three elements: setting just and equitable rates; seeking safe, reliable, and more environmentally benign utility service; and stimulating a utility to keep the total costs of service that must be incurred as low as reasonably possible. PURPA's goals are discussed. The New York approach to load management and the limits of load management are discussed. (MCW)

30758 (NP—22596, pp 499-519) **Long-term outlook for the electric-power business.** Corey, G.R. 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

The financial problems of the US electric-power industry are detailed and the causes of these problems are said to be inflation, outmoded rate regulation, a sense of frustration, and a widespread inclination of people in the public forum to denigrate the industry. Four suggestions are made for dealing with the problems and their causes, namely: find ways to modify original-cost regulation so that it will work in an inflationary environment; maintain flexibility to accept new ideas; be able to mitigate the kind of needless regulation that restricts management options; and acting with reason. A fifth point - one for which the author proposes no solution - involves the attacks on middle management who have acted usually to the best of their ability with ever-charging health and safety regulations, but who are subsequently condemned. The risk of destroying all business initiative is present.

30759 (NP—22596, pp 533-540) **Regulation and the electric-utility industry.** Swidler, J.C. 21 Oct 1980. EPRI, Palo Alto, CA.

From Rate design study regional conference; San Francisco, CA, USA (May 1980).

Contrast between present electric-utility conditions and the time when there were few rate cases (money was cheap and utilities were considered a prime investment) is made. Presently, most companies are on the edge of debt coverage, and stock dilution has proceeded so far as to warn of the possible early demise of the market for equities; increased rates are engulfed rapidly by inflation. Company deferrals and cancellations of new base-load capacity are taken for a combination of reasons, but there is great concern that at the end of the decade the country will be short of base-load capacity, especially nuclear and coal, and in desperation, utilities will be compelled to use oil-burning combustion turbines. Complexities of the utility regulatory system in the US are discussed. It is pointed out that PURPA is an example of the elaboration of the workings of federalism in an area of dual jurisdiction, where the states have traditionally exercised responsibility; although, because of the interstate nature of the electric power industry the Federal Government could, if it wished, take over some or perhaps all of the state functions. The legislation requires consideration by state regulators of various problems of national concern, without prescribing the results they must reach. (MCW)

30760 **Energy efficiency and the utilities: new directions.** Westly, S. (ed.). San Francisco, CA; California Public Utilities Commission (1980). 203p. (CONF-8004162—).

From Symposium on energy efficiency and the utilities: new directions; Stanford, CA, USA (18 Apr 1980).

The central inquiry of this symposium was what role the nation's utilities should play to encourage, and provide incentives for, energy conservation and efficiency. Five specific areas were selected as discussion topics: 1) the Utility Role in Solar; 2) the Utility Role in Conservation; 3) Load Management and Conservation Rate Design; 4) Cogeneration and Small Power Production; and, 5) New Directions for Utility Resource and Financial Planning. There was a panel (with moderator) of 3 to 5 members for each area, with a speaker introducing each session and a panel discussion following; also, there was a luncheon speaker each day: Dr. Daniel Yergin, co-editor of the Harvard Energy Study, Energy Future, on April 18; and Mr. Amory Lovins, British Representative, Friends of the Earth, on April 12. The purpose of the symposium was to provide a forum for knowledgeable and influential people from a variety of backgrounds bearing on national energy policy to exchange ideas. To this end, the CPUC invited leaders from the financial community, the utility industry, state regulatory commissions, other federal state, and local governmental bodies, the academic and research communities, public interest groups, and the media. A thoughtful and provocative dialogue resulted thus this edited publication of the proceedings was arranged to reach a wider audience.

30761 **(PB—81-119778) Electric generation expansion analysis system. A progress report on Pri 1529.** (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jun 1980. 217p. NTIS, PC A10/MF A01.

The Electric Generation Expansion Analysis System (EGEAS) is planned to provide a state-of-the-art flexible software system for electric utility capacity expansion planning which will utilize a common data base and control program for both a set of core analysis alternatives and a set of modular, advanced feature packages. The system will be based upon selected existing operating and capacity expansion software as well as upon software de-

veloped during the length of the contract. EGEAS is based upon two currently available but independent optimization packages GEM, (linear programming) developed at MIT and OPTGEN (dynamic programming) developed by Stone and Webster Engineering Corp. In addition, EGEAS will utilize the operating system model SYSGEN developed at MIT. The complete EGEAS structure will incorporate a third optimization algorithm, Generalized Benders' decomposition, and two other analysis options, Year-End Optimization and Prespecified Expansion Pathway as portions of the overall system giving five analysis options. The data structure of the MIT GEM model will be expanded and evolved to be accessed by all five analysis options.

30762 **Forecasting electric utility fossil-fuel consumption.** Uri, N.D. (DOE, Washington, DC). *Energy (Oxford) ;* **5**: No. 11, 1155-1162(Nov 1980).

The objective of this analysis is to develop a model to forecast the consumption of fossil fuels by electric utilities on a month-to-month basis. A scheme is devised and implemented that attributes fossil-fuel generation (exclusive of coal) to the consumption of residual fuel oil, distillate fuel oil, crude oil, and natural gas. A multinomial logit specification is used whereby the share of each of these fuels is a function of relative prices, weather, time, seasonal factors, and extraneous influences (e.g. a coal strike). The results agree well with actual shares. 10 refs.

30763 **Ratemaking: the problem now is the art.** Bower, R.S. pp 26-38 of Proceedings of the 1980 rate symposium on problems of regulated industries. Columbia, MO; University of Missouri (1980).

From 1980 rate symposium on problems of regulated industries; Kansas City, MO, USA (10 Feb 1980).

Ratemaking as a science and an art are discussed in this article. A case study in electrical ratemaking involving distribution of revenus among classes and the development of rate structures for each class is presented. Data are included for: class cost of service; marginal running cost; marginal cost study-demand related costs; and revenue vs cost by class. (DMC)

30764 **Public utility regulation and the decade ahead.** Perry, H. pp 99-105 of Proceedings of the 1980 rate symposium on problems of regulated industries. Columbia, MO; University of Missouri (1980).

From 1980 rate symposium on problems of regulated industries; Kansas City, MO, USA (10 Feb 1980).

The DOE is committed to strengthening the states rates in regulating public utilities. Since utilities are both major suppliers and consumers of energy, they constitute a unique sector of the energy economy and pose special opportunities and problems for public policy. Public energy policy for the 80's is discussed in regard to utility regulation. (DMC)

30765 **Electricity pricing and national energy policy.** Uhler, R.G. pp 122-130 of Proceedings of the 1980 rate symposium on problems of regulated industries. Columbia, MO; University of Missouri (1980).

From 1980 rate symposium on problems of regulated industries; Kansas City, MO, USA (10 Feb 1980).

This paper examines the relationship between electricity pricing and national energy policy. Exphasizing the importance of achieving national objectives of conservation and efficiency, the research findings of four prestigious studies are reported. The policy recommendation of these groups that energy pricing should reflect marginal costs is contrasted with the recent decision of the Ontario Energy Board.

30766 **Progress with PURPA: the activities of Pacific Gas and Electric Company in meeting the requirements of Section 133 of the Public Utility Regulatory Policies Act of 1978.** Reynolds, S.P. pp 184-199 of Proceedings of the 1980 rate symposium on problems of regulated industries. Columbia, MO; University of Missouri (1980).

From 1980 rate symposium on problems of regulated industries; Kansas City, MO, USA (10 Feb 1980).

The purpose of this article is to discuss how a utility can comply with the procedural aspects of Section 133 of the Public Utility Regulatory Policy Act (PURPA) and still meet the analytic and policy goals set forth by Congress. The progress of Pacific Gas and Electric (PG & E) in complying with federal and state requirements is described. Also discussed are some of the activities PG & E has undertaken in innovative rate design and marginal costing that are conceptually related to Section 133. Examples of the use of Section 133 data are demonstrated in a variety of cases ranging from Avoided Cost computations to the evaluation of the cost-effectiveness of conservation and load management programs. Section 133 requires utilities to produce cost-of-service data in order to improve the state-of-the-art of ratemaking and advance current retail rate design. (DMC)

30767 **Load management in operation: a consumer-voluntary program pays for the system in one hour.** Rodemann, U.W. Washington, DC; American Public Power Association (1980). 18p. (CONF-8009170—2; CONF-781284—1).

From American Public Power Association energy management and communications workshop; Myrtle Beach, SC, USA (30 Sep 1980).

The experience of the municipally owned electric utility in Albany, Georgia in setting up and operating a load management system with its related equipment for monitoring and controlling peak power demand for space conditioning and water heating in residential and commercial buildings is described. This experience demonstrated that consumers, given the opportunity to do something about energy conservation and energy costs, are willing to do so without expectation of immediate, individual rewards, and that with the proper system design and equipment, load management can pay its way almost immediately, can provide the flexibility needed in these uncertain times, and can operate without discernible effect on consumers. In one peak demand hour (June 28, 1978, ending at 6:00 p.m.), the utility was able to reduce load enough to realize a savings of $541,500, $125,596 more than the system cost. In Albany, Georgia, load management is no longer a theory. It is a working solution that not only enables the utility to control costs, but also results in capabilities to better handle both power system emergencies and a wide range of possible future developments in the energy field, including changes in rate structures and fluctuations in power supplies. (LCL)

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 30799, 30810, 30811, 30812, 30813, 30829, 30831, 30850, 30851

30768 **(PB—81-800369) Fuel consumption: industrial, residential, and general studies. 1977-October 1980 (citations from the NTIS data base). Report for 1977-October 1980.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Nov 1980. 176p. NTIS PC N01/MF N01.

Citations of research on fuel supply, demand, shortages, and conservation through effective utilization are presented. A few abstracts pertain to energy consumption in the agricultural sector, fuel substitution, economic studies, and environmental concerns relating to energy consumption. Bibliographies on electric power consumption and fuel consumption by transportation also are available. (This updated bibliography contains 140 citations, 10 of which are new entries to the previous edition.)

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 30112, 30121, 30122, 30125, 30126, 30127, 30128, 30130, 30131, 30140, 30164, 30174, 30201, 30213, 30218, 30219, 30220, 30221, 30222, 30232, 30233, 30235, 30244, 30248, 30251, 30252, 30267, 30324, 30328, 30415, 30831, 30889

30769 **(CONF-810802—2) Information resources in the USA on new and renewable energy: a description and directory.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). 1 Jun 1981. 81p. NTIS, PC A05/MF A01. Order Number DE81028867.

From Conference on new and renewable energy sources; Nairobi, Kenya (Aug 1981).

This report is a contribution of the United States of America to preparations for the 1981 United Nations Conference on New

and Renewable Sources of Energy. It describes the production dissemination, and availability of US scientific and technical information about new and renewable energy resources, the policy framework within which the technologies are developed, and the roles of public and private sectors. It also contains a directory of sources of additional information - printed material, computerized data bases, institutional services, and personal contacts - about the use of new and renewable energy. This report was prepared through the assistance of the Department of Energy's Technical Information Center, with funding and guidance from the Department of Energy and advice from an Interagency Task Force led by the Department of State. Inquiries about its contents should be addressed to the US Department of Energy, Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830.

30770 **(DOE/CE—0017) USA: living with the sun.** Collins, K.; Kepler, E.; McBride, J.; Rucker, C.; Sesso, J. (National Center for Appropriate Technology, Butte, MT (USA)). Jul 1981. Contract AP01-811A10191. 31p. NTIS, PC A03/MF A01. Order Number DE81027832.

This illustrated brochure describes and shows renewable energy demonstration projects across the country. (MHR)

30771 **(DOE/ET/29372—1) Concepts for design of an energy-management system incorporating dispersed storage and generation.** Kirkham, H.; Koerner, T.; Nightingale, D. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Apr 1981. Contract AI01-79ET29372. 131p. NTIS, PC A07/MF A01. Order Number DE81028371.

New forms of generation based on renewable resources must be managed as part of existing power systems in order to be utilized with maximum effectiveness. Many of these generators are by their very nature dispersed or small, so that they will be connected to the distribution part of the power system. This situation poses new questions of control and protection, and the intermittent nature of some of the energy sources poses problems of scheduling and dispatch. This report assumes that the general objectives of energy management will remain unchanged and discusses the impact of dispersed storage and generation on some of the specific functions of power system control, and its hardware.

30772 **Biomass: the energy source with growing potential.** Sacks, T. *Electrical Review International ;* **208**: No. 5, 16-17(6 Feb 1981).

In the intensifying search for renewable sources of energy, the potential of the energy trapped in organic matter by photosynthesis is being rediscovered. It has been estimated that by the turn of the century biomass could supply Europe with about 10 per cent of its energy needs - a similar proportion to that produced by nuclear power plants.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 31062

30773 **(ANL/MHD—80-10) Technical support for open-cycle MHD program. Progress report, April-June 1980.** Doss, E.D. (ed.). (Argonne National Lab., IL (USA)). Aug 1980. Contract W-31-109-ENG-38. 78p. NTIS, PC A05/MF A01. Order Number DE81028476.

The support program for open-cycle MHD at Argonne National Laboratory is developing the analytical tools needed to investigate the performance of the major components in the combined cycle MHD/steam power system. The analytical effort is centered on the primary components of the system that are unique to MHD and also on the integration of these analytical representations into a model of the entire power producing system. The present project activities include modeling of the combustor, MHD channel, diffuser, radiant boiler, secondary combustor, steam turbine, and air heater. In addition, these models are combined into a model of a complete system that is at present, capable of carrying out optimizations of the entire system relative to either thermodynamic efficiency or cost of electrical power. Also, in support of other aspects of the open-cycle program, test plans are developed and facility and program reviews are provided upon request in support of the needs and requirements of the DOE/MHD Division.

30774 **(DOE/ET/10775—T1) Characterization of open-cycle coal-fired MHD generators. 14th/15th quarterly technical progress report, February 1-July 31, 1980.** Wormhoudt, J.; Yousefian, V.; Weinberg, M.; Kolb, C.; Martinez-Sanchez, M.; Cheng, W.; Bien, F.; Dvore, D.; Unkel, W.; Stewart, G. (Aerodyne Research, Inc., Bedford, MA (USA)). Sep 1980. Contract AC01-76ET10775. 64p. NTIS, PC 04/MF A01.

The successful design of full-scale, open-cycle, coal-fired MHD generators for baseload electrical production requires a detailed understanding of the plasma chemical and plasma dynamic characteristics of anticipated combustor and channel fluids. Progress in efforts to model the efficiency of an open-cycle, coal-fired MHD channel based on the characterization of the channel flow as well as laboratory experiments to validate the modeling effort as detailed. In addition, studies related to understanding arcing phenomena in the vicinity of an anode are reported.

30775 **(DOE/ET/15529—T2) MHD-generator electode development. Quarterly report for January-March 31, 1981.** (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Jun 1981. Contract AC01-79ET15529. 80p. NTIS, PC A05/MF A01. Order Number DE81028538.

The objective of this program is to develop economic MHD electrode and insulator designs that will sustain long term open-cycle MHD generator operations. Emphasis within this program is directed towards the understanding and development of cold metallic electrodes which are alternatives to the continued use of platinum as an anode clad material. Results of laboratory screening tests are presented for materials previously tested by AVCO and for other available commercial alloys. Results of anode arc tests are compared to observations from electrodes tested in an MHD generator. Laboratory electrochemical corrosion testing has been conducted at two temperatures in molten salts. Initial results from these tests are reported and analyzed. Fabrication of two commercial alloys with 7% platinum included was accomplished and electrochemical testing performed. A superior high temperature performance was noted. WESTF facility checkout and activation operations have been completed and facrication of the base copper electrode test section is reported. Detailed engineering and test planning activities in support of WESTF tests are reported.

30776 **(DOE/ET/15601—T2) Testing and evaluation of heat recovery/seed recovery. Quarterly technical progress report, March, April, May, June 1980.** Wehr, A.G.; Wade, M.L.; (eds.). (Mississippi State Univ., Mississippi State (USA). MHD Energy Center). Jul 1980. Contract AC02-80ET15601. 159p. NTIS, PC A08/MF A01. Order Number DE81027443.

Mississippi State University has constructed a Test Stand that can simulate MHD environments, and this facility was used to study the effect of combustion stoichiometry and secondary combustion on nitrogen oxide generation, heat transfer, and gas stream properties. Mathematical models are being developed and evaluated for the heat transfer in hot-wall test sections, and the prediction of NO/sub x/ levels generated during hydrocarbon combustion. Radiant boiler test sections have been built for the Test Stand, and a radiant boiler test system has been designed to provide water/steam at the proper temperature and pressure for the test sections. Packaged microprocessor-controlled diagnostic instrumentation is being developed, constructed, and evaluated for use in characterizing MHD system parameters. The instrumentation includes a two-color pyrometer, sodium line reversal system, laser transmissiometer and a laser doppler velocimetry system. Work is also underway to utilize a Coherent Anti-Stokes Raman Spectroscopy (CARS) system, an optical nitric oxide detection system, and a particle size distribution system.

30777 **Comparison of use of Hottel chart and the zone method for radiative heat transfer in our open cycle MHD radiant boiler.** Sistino, A.J. (Argonne Natl Lab, Ill). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-44, 1-10(Jul 1980).

Two methods are used to calculate the temperature profile in the radiant boiler of an open-cycle MHD system. The results of the two methods are compared. For temperatures at the exit of the boiler, the results differ by 150 K. The effect on NO/sub x/ decomposition is given for the temperature profile determined by each of the two methods of calculating radiative heat transfer. 7 refs.

3003 Thermoelectric Generators

30778 (DOE/ET/33003—T4) 900-755 degradation model for an RTG with a silicon-germanium thermopile. Stapfer, G. (Jet Propulsion Lab., Pasadena, CA (USA)). Sep 1976. Contract AI03-76ET33003. 76p. NTIS, PC A05/MF A01. Order Number DE81025714.

This report describes the RTG degradation mechanisms which have been identified as occurring in thermoelectric power generating systems that use the alloy of silicon germanium as the thermoelectric material and that incorporate a multifoil thermal insulation system. The synergetic effects of all of the identified degradation mechanisms are determined by a computer code, DEGRA, which calculates the available generator output power as a function of generator operating time.

30779 (DOE/ET/33003—T5) Copper-selenide system, P-Type TPM-217. Stapfer, G. (Jet Propulsion Lab., Pasadena, CA (USA)). Apr 1977. Contract AI03-76ET33003. 23p. NTIS, PC A02/MF A01. Order Number DE81025715.

Thermoelectric properties of P-Type copper selenides for use with N-Type gadolinium-selenide alloys in radioisotope thermoelectric generators for spacecraft power supplies are reported. (WHK)

30780 (DOE/ET/33003—T6) Program of thermoelectric generator testing and RTG degradation mechanisms evaluation. Progress report No. 38. Lockwood, A.; Shields, V. (Jet Propulsion Lab., Pasadena, CA (USA)). Nov 1980. Contract AI03-76ET33003. 46p. NTIS, PC A03/MF A01.

The n-type gadolinium selenide legs after 17,500 hours continue to show reasonable agreement with the 3M Co. published thermal conductivity data. Weight loss for both coated and uncoated Si-Ge material produced by G.E. are reported. No significant discrepancies with the results previously obtained on R.C.A. material from the MHW program have been found. Thermal conductivity measurements are also in agreement. The remaining MHW generator on test, Q1-A, has accumulated 26,800 hours and performance remains stable. The performance of the 18 couple modules S/N-1, S/N-2, and S/N-3 to date is summarized. Telemetry data indicate no changes in the trends of degradation of LES 8 and 9 and the Voyager RTGs.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 30696, 30897

30781 (BNL—29821) Electrocatalysis at oxide-covered metal electrodes. Gottesfeld, S.; Rishpon, J.; Srinivasan, S. (Brookhaven National Lab., Upton, NY (USA); Tel Aviv Univ. (Israel). Dept. of Chemistry). 1981. Contract AC02-76CH00016. 18p. (CONF-8105105—1). NTIS, PC A02/MF A01. Order Number DE81027650.

From Symposium on electrocatalyis; Minneapolis, MN, USA (10 May 1981).

Thick oxide layers grown electrochemically on Rh, Ir, Ru and their alloys exhibit electrocatalytic properties associated with an internal redox process. For simple faradaic processes at the Rh/Rh oxide electrode it is shown that the rates of charge transfer and transport depend critically on the interaction between the redox couples in solution and in the oxide at the oxide electrolyte interface. The phenomenon of anodic activation found for the o.e.r. at Ru and Ru alloys is shown to be associated with film growth (monitored optically) and with the enhancement of the internal redox activity in the oxide.

30782 (DOE/ET/11319—T3) Development of molten-carbonate fuel cells for power generation. Six-months progress report, August 15, 1977-February 15, 1978. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). Mar 1978. Contract AC02-77ET11319. 192p. NTIS, PC A09/MF A01. Order Number DE81026172.

Progress is reported on a Phase I effort which has as its objectives the development of promising concepts to circumvent a number of outstanding technical challenges in molten carbonate fuel cell technology and the better definition of the operating limits of molten carbonate fuel cells and power plants based thereupon. Emphasis has been on system definition and understanding, fuel cell and test stand design, procurement, and construction, and electrolyte tile fabrication development. In addition, molten carbonate fuel cells have been operated using components designed and fabricated (except electrodes) at General Electric. Specific accomplishments include the completion of a survey of coal gasification processes (with emphasis on characteristics relevant to full cell integration), system integration studies, fuel gas and electrolyte chemistry studies, and the development of a parametric fuel cell model. Electrolyte tile composition synthesis has centered upon the composition 60 w/o (62 m/o Li_2CO_3 + 38 m/o K_2CO_3) + 40 w/o $LiAlO_2$; electrolyte tiles have been fabricated in sizes up to 10 1/2" square by hot pressing. Fuel cell hardware incorporating 2" square and 3" square electrolyte tiles, respectively, has been designed and operated.

30783 (DOE/ET/11322—T4) Performance model for molten-carbonate fuel cells. Quarterly report, 5 January-5 April 1979. Wilemski, G.; Wolf, T.; Bloomfield, D.; Finson, M.L.; Pugh, E.R.; Wray, K.L. (Physical Sciences, Inc., Woburn, MA (USA)). 1979. Contract AC02-78ET11322. 67p. NTIS, PC A04/MF A01.

Progress on the development of a performance model for molten carbonate fuel cells is reported. Key physical and chemical phenomena being modeled include mass transport, ohmic losses, electrode kinetics, fuel and oxidant utilization, gas phase convective heat transfer and inplane heat conduction through cell hardware. Numerical schemes have been developed and programmed to calculate overpotential versus current density curves for individual electrodes, the cell current density distribution, and the cell temperature distribution.

30784 (DOE/ET/11325—T1) Hydroprocessing of heavy oils for the production of fuel-cell quality fuels. Final technical report, September 30, 1977-September 30, 1978. Jarvi, G.A.; Camara, E.H.; Marianowski, L.G.; Lee, A.L.; Vasil, D.R.; Oberle, R.D. (Institute of Gas Technology, Chicago, IL (USA)). 1978. Contract AC02-77ET11325. 115p. (SAN—1558-4). NTIS, PC A06/MF A01.

Progress is reported on a program to establish whether heavy oils such as No. 4 or No. 6 fuel oil can be hydrogasified or hydrotreated to produce a steam-reforming feed suitable for use in an integrated fuel cell power generation facility. Hydrogasification data show that methane is the major gas product, along with a certain amount of coke formation. The liquid product was similar to the feed oil indicating that the oil did not fully enter the reaction. The hydrotreating apparatus was fully tested and proved to be operational. A trial run on No. 4 fuel oil using a Ni/MoO_3 hydrodesulfurization finishing catalyst showed very good sulfur removal to the gas phase, along with substantial reduction of specific gravity in the liquid product over the feed oil. Whereas the coke formation during hydrogasification is a clear disadvantage, further testing is required of the hydrotreating catalysts to determine quantitatively how efficient the sulfur removal can be and how amenable steam reforming the hydrotreated oil will be.

30785 (EPRI-EM—1936) Effect of alternate fuels on the performance and economics of dispersed fuel cells. Final report. Buggy, J.J.; Krasicki, B.R.; Lance, J.R.; Pierce, B.L.; VanBibber, L.E. (Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1981. 187p. NTIS, PC A09/MF A01.

An assessment of the effects of alternative fuels-natural gas, coal-derived medium-Btu gas, methanol, ethanol, and naphtha-on the performance and economics of conceptual phosphoric acid fuel

cel (PAFC) power plants is presented. Analysis of (1) properties of typical examples of these fuels; (2) PAFC requirements for preliminary specification for fuel processing systems; and (3) vendor-supplied cost, performance, and operational data on fuel processing systems to define ten PAFC power plant configurations utilizing the five alternative fuels is described.

30786 **Method of preparing a sintered lithium aluminate structure for containing electrolyte.** Kinoshita, K.; Sim, J. W. (to Department of Energy). US Patent 4,251,600. 17 Feb 1981. Filed date 27 Dec 1979. vp.

A porous sintered tile is formed of lithium aluminate for retaining molten electrolyte within a fuel cell. The tile is prepared by reacting lithium hydroxide in aqueous solution with alumina particles to form beta lithium aluminate particles. The slurry is evaporated to dryness and the solids dehydrated to form a beta lithium aluminate powder. The powder is compacted into the desired shape and sintered at a temperature in excess of 1200 K. But less than 1900 K. To form a porous integral structure that is subsequently filled with molten electrolyte. A tile of this type is intended for use in containing molten alkali metal carbonates as electolyte for use in a fuel cell having porous metal or metal oxide electrodes for burning a fuel gas such as hydrogen and/or carbon monoxide with an oxidant gas containing oxygen.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 30768

30787 (CONF-790346—, pp 8p, Paper 8) **Texas Instruments' role in energy management.** Van Riper, E. (Texas Instruments, Inc., Dallas). 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

Two control systems for energy management, manufactured by Texas Instruments, are described. The flexibility of the 5TI system is reviewed and its capabilities are discussed. The Program Master 550 features 3-mode feedback loop control, math features, the same logic features as the 5TI, and complete data handling capabilities. It is a dual-based microprocessor system. Some specific information on the 5TI energy management real time clock program and its use as a power demand control is given. (MCW)

30788 (CONF-790346—, pp 8p, Paper 11) **Energy conservation through controls design.** Paoluccio, J. (Joseph Paoluccio-Consulting Engineers, San Diego, CA). 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

A synopsis, supplemented with various graphs, describes Dead Band Control Strategy; a Dead Band Control Guide; and Computer Modeling. Computer modeling was used to predict relative energy consumption for buildings and control strategies addressed in the Dead Band Controls Guide on installation, operation, and maintenance estimating aid. Climatic zones analyzed were San Diego, Great Lakes (Illinois), and Pensacola. (MCW)

30789 **(DOE/CS/10045—T3) Projecting regional potentials for cost-effective energy conservation and renewable resource applications: a feasibility study.** (Natural Resources Defense Council, Inc., San Francisco, CA (USA)). 1980. Contract FG03-79CS10045. 52p. NTIS, PC A04/MF A01.

The feasibility is discussed of preparing an instruction manual that would enable a modeler in a particular region to set up a calculation method for predicting energy use. Such a manual would concern itself primarily with the three energy-consuming sectors most relevant to utilities' demand projections. Data requriements for each of the three sectors (residential, commercial, and industrial) are described and some initial guidance is provided as to how these needs can be filled. The methods for separate calculations of energy consumed by each end use in each sector are described. Each end use is discussed separately for the residential sector, but only in aggregate for the commercial and industrial sectors. (MCW)

30790 **(DOE/CS/20205—T10) Revised BCS resource-allocation methodology. Final report.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 19 Sep 1979. Contract AC03-77CS20205. 202p. NTIS, PC A10/MF A01.

An evaluation of the methodology of the Resource Allocation's Model (RAM), developed to assist in developing an efficient research, development, and demonstration program for energy conserving technologies in the residential and commercial sectors, is presented. This evaluation begins by classifying the technologies according to the markets in which they will compete once they are commercialized. Within each market group, the probable costs of the new technologies are compared to the cost of the competitive conventional product. This information is used to calculate the expected energy savings of each portfolio of projects. Portfolios are then ranked in order of increasing energy savings, and estimates made of the value of various levels of funded research in each functional use area. Finally, successful portfolios in different market groups are compared in a similar manner in order to identify the most efficient comprehensive portfolio at each research funding level. Section 2 describes the original methodology and presents some of the modifications that were made during this task. Section 3 discusses the specific changes that were made, including improvements to the model as well as the development of more reliable data. The revised methodology is then applied to one market group to demonstrate its capabilities and limitations. Section 4 includes a summary of the results and an updated set of RAM runs. The final section discusses the limitations of the modified methodology and describes the aspects of RAM that need further development.

30791 **(DOE/CS/20205—T11) RAM2 resource-allocation methodology. Final report.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 1 Nov 1978. Contract AC03-77CS20205. 63p. NTIS, PC A04/MF A01.

The development of the Division of Buildings and Community Systems Resource Allocation Model RAM2 is described. The model provides a means of comparing the energy savings of various research portfolios which provide the greatest savings at various levels of research funding. The details of the methodology for these analyses are presented in Section 1. Section 2 presents an example application of the RAM2 methodology. Seven market groups are analyzed. Development of the inputs and results of the RAM2 runs are presented. (MCW)

30792 **(DOE/CS/20205—T12) Retrospective (in-process) project evaluation system. Final report.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 20 Dec 1978. Contract AC03-77CS20205. 106p. NTIS, PC A06/MF A01.

The retrospective evaluation methodology is being developed to monitor progress in energy conservation projects and to evaluate their success at completion. The criteria for evaluation will vary according to the project, the anticipated role that the federal government expects to play in development and commercialization, and the level of technology development. Evaluation guidelines are presented and their application is illustrated using a residential water heater refit kit; energy conservation in restaurants; and a national infrared thermography program. (MCW)

30793 **(DOE/CS/20205—T13) Threshold evaluation data revision and computer program enhancement. Final report.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 27 Feb 1979. Contract AC03-77CS20205. 120p. NTIS, PC A06/MF A01.

The Threshold Evaluation System was developed to assist the Division of Buildings and Community Systems of the Department of Energy in performing preliminary evaluation of projects being considered for funding. In addition, the evaluation has been applied to on-going projects, because information obtained through RD and D may alter the expected benefits and costs of a project, making it necessary to reevaluate project funding. The system evaluates each project according to its expected energy savings and costs. A number of public and private sector criteria are calculated, upon which comparisons between projects may be based. A summary of the methodology is given in Appendix B. The purpose of this task is to upgrade both the quality of the data used for input to the system and the usefulness and efficiency of the computer pro-

gram used to perform the analysis. The modifications required to produce a better, more consistent set of data are described in Section 2. Program changes that have had a significant impact on the methodology are discussed in Section 3, while those that affected only the computer code are presented as a system flow diagram and program listing in Appendix C. These improvements in the project evaluation methodology and data will provide BCS with a more efficient and comprehensive management tool. The direction of future work will be toward integrating this system with a large scale (at ORNL) so that information used by both systems may be stored in a common data base. A discussion of this, and other unresolved problems is given in Section 4.

30794 **(DOE/CS/20205—T15) Building and community systems resource-allocation model. Final report.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 13 Feb 1978. Contract AC03-77CS20205. 54p. NTIS, PC A04/MF A01.

The paper discusses development of a resource allocation methodology for the BCS group to determine which energy conservation projects to fund if it is not possible to support all candidate programs and to determine how many projects to fund in one area to maintain minimal duplication. The current status of the methodology is presented. Section II deals with the technique used to evaluate a single portfolio. Section III describes the algorithm used to select the portfolios for evaluation. The search technique is described in Section IV. Information on the overall portfolio in Section IV is tabulated according to rank, project number, funding level, group number, research cost of addition, net benefit, marginal benefit, marginal rate of return, and cumulative rate of return. A summary of results is presented in Section V and group results are presented in Section VI. A table in Section VII lists the projects in numerical order with their group number, possibility of success, energy cost savings with and without DOE funding, and research cost of the project. (MCW)

30795 **(JPL-PUB—81-61) Regional characteristics relevant to advanced technology cogeneration development.** Manvi, R. (Jet Propulsion Lab., Pasadena, CA (USA)). Jul 1981. 150p. NTIS, PC A07/MF A01. Order Number DE81028370.

The Cogeneration Technology Alternatives Study was aimed at providing a data base to assist DOE in establishing research and development funding priorities in the area of advanced energy conversion technology. Those specific factors within various regions of the country that may influence cogeneration with advanced energy conversion systems were studied. Regional characteristics of advanced technology cogeneration possibilities are discussed, with primary emphasis given to coal-derived fuels. Factors considered for the study were regional industry concentration, purchased fuel and electricity prices, environmental constraints, and other data of interest to industrial cogeneration.

3201 Buildings

REFER ALSO TO CITATION(S) 30217, 30230, 30661, 30700, 30706, 30706, 30864, 31107

30796 **(AD-A—090828) EMCS Modules/intelligent Time Clock (ITC). Final report 1977-1980.** Shiroma, D. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Sep 1980. 23p. NTIS, PC A02/MF A01.

The CEL has developed a microprocessor-based intelligent time clock (ITC) for control of HVAC equipment. The ITC has the capability of operating as a stand-alone controller, or as part of a distributed large-scale Energy Monitoring and Control System (EMCS). The ITC has 'intelligence' to monitor actual environmental conditions and to base actual control functions on these data. Evaluation of the ITC has demonstrated that such 'intelligent' control devices can provide significant energy savings over conventional control devices.

30797 **(AD-A—091723) Army energy data analysis. Final report.** (Army Facilities Engineering Support Agency, Fort Belvoir, VA (USA). Technology Support Div.). Aug 1980. 231p. NTIS PC MF A01.

This study consists of a thorough analysis of the Facilities Engineering Annual Summary of operations, 'Red Book,' for fiscal years 1975 through 1979 in order to develop energy performance indicators for and a profile of energy use in Army facilities within the United States. This report presents statistical data at a detailed level for each US Army Installation and aggregated by each Major Command.

30798 **(AD-A—091843) Performance evaluation of point-of-use water heaters. Final report 1 sep 79-15 oct 80.** Shepherd, P.B. (Johns-Manville Sales Corp., Denver, CO (USA). Research and Development Center). 15 Oct 1980. Contract DAAK70-78-D-0002. 93p. NTIS, PC A05/MF A01.

Point-of-use water heaters are designed to be installed at the location where hot or warm water is used. Thus, such water heaters may be connected to a water faucet, dishwasher, clothes washer, shower or the like. Two types of heaters are available. One is referred to as instantaneous and it has no storage capacity. The second is a very small 1/2 to 6 gallon storage tank type of heater which has nearly negligible standby losses. Point-of-use water heaters offer the greatest potential for energy conservation on Army facilities when used as boosters for domestic dishwashers and to replace large storage heaters in buildings where the only requirement for hot or cold tepid water is in lavatories. A method has been developed to calculate the energy conservation potential of water heaters. The results of this method may be used for life-cycle cost analysis.

30799 (CONF-790346—, pp 9p, Paper 6) **Ranking energy uses in commercial buildings.** Sidley, N.A. (Honeywell, Inc., Minneapolis, MN). 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

Practical energy usage in commercial buildings, which depends on how much energy can be saved for how many dollars spent to effect the savings, is discussed. Data collected by the Building Owners and Managers Association, DOE, the American Institute of Architects, and others on energy consumption in buildings are available to compare specific building data with their averages or standards. A reference list is given to provide information to assess the relevance of any energy saving technique for any specific building. (MCW)

30800 (CONF-790346—, pp 11p, Paper 7) **Energy management systems for small commercial/industrial applications.** Jorgenson, D.R. 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

Inexpensive control systems for energy management systems that fully utilize economic incentives available (in terms of payback and performance) for small commercial/industrial applications are discussed. Requirements of such control systems and problems associated with their application are covered as well as methods and equipment that may be employed to make them viable energy management tools for both consumers and utilities. Specifically, the use and performance of the Sentrol computerized management systems are described. (MCW)

30801 (CONF-790346—, pp 5p, Paper 9) **Energy conserving opportunities using temperature controls.** Terhune, J. 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

Some of the control basics which contribute to an energy efficient system are examined. The performances of the air mixing section, the tempering or coil section, and room thermostats are discussed. Features of some specific thermostats are noted. (MCW)

30802 (CONF-790346—, pp 5p, Paper 10) **Effective utilization of energy management systems.** Hallanger, E.C. 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

Four criteria or benchmarks that will help to select a sound, working energy management system are reviewed. Economics, cor-

rect application, local support, and monthly audits are indicated. (MCW)

30803 (CONF-790346—, pp 11p, Paper 12) **Case Study 26. Project: Georgia Power Co., Corporate Headquarters, Atlanta.** Lord, L. (Heery and Heery Architects and Engineers, Inc., Atlanta, GA). 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

The design of a 24-story office tower and three-story, solar collector-crowned base is described and is expected to consume 43% less energy than its avcrage counterpart. The building features a large scale, active solar collection system to further reduce purchased energy for heating and cooling, and special lighting equipment is expected to reduce electrical energy demand. The program, design, energy system, and predicted performance are discussed. (MCW)

30804 (CONF-790346—, pp 19p, Paper 15) **Grand scheme/an economist's view of energy conservation.** Ruegg, R. 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

An overview of the role economics can play in energy conservation is presented. How economics can help designers, engineers, builders, manufacturers, public utilities, policy makers, and consumers solve specific problems is addressed. An example of economics applied to the evaluation of the energy and cost performance of alternative window systems is given. (MCW)

30805 (CONF-810812—32) **Annual cycle energy system experimental performance and national applicability.** Baxter, V.D. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE81028570.

From IECEC conference; Atlanta, GA, USA (9 Aug 1981).

A single-family residence in Knoxville, Tennessee has been used to demonstrate the energy conserving potential of the Annual Cycle Energy System (ACES). For the past two years the performance of the ACES has been compared with that of two different air-to-air heat pumps in an identical house, the control house. The two heat pumps had ARI-rated COPs of 2.46 and 3.11 at 8.3°C, representing both standard and best available heat pumps now on the market. Hot water for the control house was supplied by an electric resistance heater each year, while hot water for the ACES house was supplied by the ACES mechanical package. Performance results for the period December 1978 through September 1979 show that the ACES consumed 6719 kWh of electricity for an annual coefficient of performance (ACOP) of 2.80. The control house (with the ARI-2.46 heat pump) consumed 12,853 kWh of electricity, yielding an ACOP of 1.42. For December 1979 through September 15, 1980, the ACES consumed 6447 kWh of electricity for an ACOP of 3.08 while the control house, using the ARI-3.11 heat pump, consumed 11,358 kWh for an ACOP of 1.73. The ACES has achieved nearly all of its theoretical performance predictions and has verified its design criteria. This system has delivered residential heating and cooling services while consuming only 57% as much electricity as the best conventional alternative tested. Computer studies have shown the ACES to be applicable to all US climatic zones except those with very low heating needs.

30806 (CONF-7705189—1) **Energy-utilization analysis of the International Energy Agency test buildings using the Cal-ERDA program.** (Lawrence Berkeley Lab., CA (USA)). 1977. Contract AM03-76SF01179. 18p. NTIS, PC A02/MF A01.

From Meeting of the experts group on buildings and community systems; Capenhurst, UK (4 May 1977).

The Cal-ERDA computer program for the analysis of building energy requirements has been used to analyze the International Energy Agency test building. An introduction to Cal-ERDA and a brief description of the system organization and capabilities are provided. The Building Description Language (BDL) used to input Cal-ERDA represents a major advance in ease and flexibility of input. The fundamentals of BDL and illustrative examples of the use of BDL in the analysis of the IEA test building are discussed in some depth.

30807 (DOE/CS/20019—T2) **Model code for energy conservation in new building construction.** (Building Officials and Code Administrators International, Inc., Chicago, IL (USA); International Conference of Building Officials, Whittier, CA (USA); Southern Building Code Congress International, Inc. (USA)). Jan 1977. Contract AC03-76CS20019. 62p. NTIS, PC A04/MF A01. Order Number DE81026147.

A proposed code for energy conservation in new building construction is presented. The intent of the code is to provide a means of implementing the provisions of ASHRAE 90-75. Differences in the code when compared to ASHRAE are pointed out. The text of the code is presented and contains these sections: Administrative; Definition; Design Conditions; Building Design by Systems Analysis and Buildings Utilizing Non-Depletable Energy Sources; Component Design; and acceptable practice. (MCW)

30808 (DOE/CS/20205—T14) **Development of a demonstration program for retrofit of ECRR measures on existing dwelling units.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 8 Dec 1978. Contract AC03-77CS20205. 75p. NTIS, PC A04/MF A01.

Policy measures which could be part of a Federal program to encourage energy conservation in renter-occupied housing are discussed. The report summarizes data on the renter-occupied housing stock and energy consumption specific to structure type, functional use, fuel type, and region. Energy conservation opportunities and factors which impede the realization of those opportunities are identified. Incentives and programs are suggested that could reduce energy consumption in rented housing. A number of issues of programmatic significance, considering several concepts which could form the basis for demonstration programs under Section 509 of ECPA, are discussed. The potential costs and benefits of a national program stemming from the demonstration efforts are discussed. (MCW)

30809 (DOE/EIA—0278) **Nonresidential buildings energy consumption survey: fuel characteristics and conservation practices.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jun 1981. 348p. NTIS, PC A15/MF A01. Order Number DE81027671.

This report presents data on energy uses and on conservation practices employed in nonresidential buildings for the 48 contiguous states and the District of Columbia. The information was collected through personal interviews conducted with building representatives between October 1979 and January 1980. A summary of the survey design, data collection procedures, and techniques used to convert the sample data to national estimates is found in Appendix A. The data are presented in two basic sets of tables. The first set presents estimated counts and percent distributions by fuel end uses, fuel oil conversions, number and types of fuels used, types of heating and cooling systems, and percentage of the building heated or cooled for selected building characteristics. These building characteristics include: location, structural features, use and occupancy characteristics, and types of heating and cooling systems. The second set presents the same building characteristics by energy conservation features of the buildings (additions of insulation, weatherstripping and caulking, treated glass and outside shading) and conservation practices (reduction in heating and cooling and regular maintenance) undertaken by the building management. Information presented in additional appendices are: limitations of the data; a copy of the building questionnaire; US weather zone map; census regions; utility forms; and a glossary. (MCW)

30810 (DOE/EIA/10085—T1(Pt.1)) **National Interim Energy-Consumption Survey. Part I. Household and utility-company surveys.** (Response Analysis Corp., Princeton, NJ (USA)). 30 Jun 1981. Contract AC01-79EI10085. 78p. (DOE/EIA—0295/1). NTIS, PC A05/MF A01. Order Number DE81026311.

The methodology for the National Interim Energy Consumption Survey (NIECS), an integrated set of data collections, data files, and analyses which bring together surveys of households and of utility companies and fuel dealers who serve them, is presented in six separate parts. Surveys of rental agents provide sup-

plemental information and a transportation panel provides information on miles traveled and fuel consumption of household vehicles. A total of 4081 questionnaires were completed, including 3842 personal face-to-face interviews and 239 mailed questionnaires. Information on sampling and estimating procedures, conducting the household and utility company data collection, data preparation and editing, and imputations and adjustments for missing data is presented in part I. Specific information was asked on end uses of fuels consumed by the households, energy conservation activities, household vehicles, and characteristics of the housing unit and its residents. A chronology and guide to the report are given in Part I. (MCW)

30811 (DOE/EIA/10085—T1(Pt.2)) National Interim Energy-Consumption Survey. Part II. Household and utility-company surveys. Appendix A. (Response Analysis Corp., Princeton, NJ (USA)). 1981. Contract AC01-79EI10085. 304p. (DOE/EIA—0295/2). NTIS, PC A14/MF A01. Order Number DE81026310.

Appendix A of the National Interim Energy Consumption Survey (methodology) an integrated set of data collections, data files, and analyses which bring together surveys of households and of the utility companies and fuel dealers who serve them, is presented. Forty-four items (letters, records, instructions, questionnaires, etc.) concerned with the survey are included and are categorized into these areas: household survey materials; household survey reassignment materials; interview verification materials; authorization form followup; mailed questionnaire materials; survey of fuel oil and LPG companies; survey of electric and utility gas companies; rental agent survey; and full oil survey. (MCW)

30812 (DOE/EIA/10085—T1(Pt.3)) National Interm Energy-Consumption Survey. Part III. Household and utility-company surveys. Appendices B through G. (Response Analysis Corp., Princeton, NJ (USA)). 1981. Contract AC01-79EI10085. 158p. (DOE/EIA—0295/3). NTIS, PC A08/MF A01. Order Number DE81026080.

Six appendices to the National Interim Energy Consumption Survey (methodology), an integrated set of data collections, data files, and analyses which bring together surveys of households and of utility companies and fuel dealers who serve them, are presented. Data files prepared for household and fuel consumption data; editing and coding instructions for household questionnaire; computer editing specifications for personal interview questionnaire; editing and coding instructions and forms for fuel consumption data; regression procedures for fuel consumption imputations; and imputations for item nonresponse in household questionnaire are presented. (MCW)

30813 (DOE/EIA/10085—T1(Pt.6)) National Interim Energy-Consumption Survey. Part VI. Energy assessment. (Response Analysis Corp., Princeton, NJ (USA)). 1981. Contract AC01-79EI10085. 251p. (DOE/EIA—0295/6). NTIS, PC A12/MF A01. Order Number DE81027605.

The goal of energy assessment of the housing unit is to obtain physical information which can be combined with other survey results to give a more complete picture of the residential environment. A limited pretest of an energy assessment procedure was carried out in April-June 1979 with a subsample of 44 households that had been originally interviewed in the National Interim Energy Consumption Survey. In order to gain experience under a variety of environmental conditions, the pretest sites included locations in the Northeast, North Central, and South regions. As developed for the pretest, the energy assessment was a 90-minute inspection of the housing unit by a trained technician. Data collected during the inspection included square footage of the unit; age, make, and characteristics of appliances; insulation characteristics, characteristics of siting and apertures; and detailed information on the heating and cooling systems in the unit. The report describes the data collection procedures for the pretest.

30814 (DOE/TIC—1028181) State of Missouri energy-conservation program: energy savings through controls and heat recovery in building systems. (Johnson Controls, Inc., Milwaukee, WI (USA)). 1979. 96p. NTIS, PC A05/MF A01. Order Number DE81028181.

The conservation aspects of room temperature and relative humidity control; the unoccupied cycle; use of outdoor air; supply air and water reset; electric energy management; and heat recovery are covered. A savings analysis is presented for each program and the calculation method is noted. (MCW)

30815 (DOE/ZZ/01320—T1) Energy-information dissemination into the real-estate industry. Draft final report. Isakson, H.R. (Washington State Univ., Pullman (USA). Coll. of Business and Economics). 1 Jun 1979. Contract AS01-78ZZ01320. 117p. NTIS, PC A06/MF A01. Order Number DE81025489.

A description is presented of a set of nine slide/tape programs and two sets of overhead transparencies that were developed to accompany earlier designed curriculum for real estate professionals. The present project includes the development of standardized implementation procedures for use by energy extension service offices and an instructor's manual designed to integrate use of the slide/tape programs and overhead transparencies with the textbook, Making the Most of Energy in Real Estate, which was developed earlier. (MCW)

30816 (EMD—81-47) Energy-conservation program for schools and hospitals can be more effective. (General Accounting Office, Washington, DC (USA)). 23 Mar 1981. 41p. General Accounting Office, Gaithersburg, MD. Order Number DE81904051.

Report to the Congress by the Comptroller General of the United States.

Changes which could increase overall energy savings without increasing program funding in the Schools and Hospitals Program are identified. Improvements needed in DOE's management of the program are also identified. (MCW)

30817 (LA-UR—81-2288) Ultimate in building energy analysis: DOE-2 and BLAST. Hunn, B.D. (Lawrence Livermore National Lab., CA (USA)). 1981. Contract W-7405-ENG-36. 33p. (CONF-8105107—1). NTIS, PC A03/MF A01. Order Number DE81028703.

From Symposium on energy and big building design; Philadelphia, PA, USA (25 May 1981).

Many building energy analysis tools, ranging from the simplest to the most sophisticated, are applicable to the design of large commercial buildings. This paper focuses on two of the sophisticated, detailed, and most powerful of these tools: the DOE-2 and BLAST computer programs. DOE-2 and BLAST are generally classed as high-level, computer-dynamic methods that are based on hour-by-hour computation. These tools are placed in the context of building energy analysis, and the motivation for their development is traced. The characteristics of DOE-2 and BLAST are discussed, with emphasis on their solar simulation features, and their capabilities are contrasted and related. Three case studies, illustrating typical applications of the programs to the retrofit of existing buildings and the design of new buildings, are presented: a passive solar retrofit of an office building, the use of DOE-2 as a predesign analysis tool, and the use of BLAST in a research and development application. Future directions in research and development needs for high-level building energy analysis tools and the progress being made toward increased use of these tools are discussed.

30818 (LBL—12288) Thermal performance of windows having high solar transmittance. Rubin, M.; Selkowitz, S. (Lawrence Berkeley Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 6p. (CONF-810925—16). NTIS, PC A02/MF A01. Order Number DE81028872.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

Antireflected polyester films and low-iron glass sheets have values of solar transmittance that are substantially higher than those of their untreated counterparts. The plastic films utilize coatings to reduce loses due to surface reflectance and the glass is made with low levels of impurities to reduce adsorption within the material itself. The optical and thermal properties of these materials are discussed and the solar and thermal characteristics of windows incorporating high-transmittance glazing layers are derived. Comparisons among these and other types of windows are made on the basis of net energy use for residential buildings in winter.

30819 (LBL—12659) Energy-efficient management of lighting in a Veterans Administration medical center. Verderber, R.R.; Arthur, A.; Morse, O.; Rubinstein, F. (Lawrence Berkeley Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 68p. NTIS, PC A04/MF A01. Order Number DE81029433.

More thn 200 solid-state fluorescent ballasts were installed in representative areas of the Veterans Administration Medical Center in Long Beach, California, to determine the cost-effectiveness of the installation and to measure levels of conducted and radiated electromagnetic interference (EMI). The power, illumination, and EMI levels were measured first as the test sites initially existed, then after the fixtures were cleaned and relamped with energy-saving fluorescent lamps, and finally after the core-coil ballasts were replaced with solid-state ballasts. The annual energy savings for the complete retrofit was measured as 34%. In the director's suite natural daylight was used to supplement the electrical illumination, saving an additional 20 to 25% in energy. Thus, in that area, the total annual energy savings amounted to 51%. EMI levels were measured in general areas (lobby and director's suite), in diagnostic examination areas, and in a coronary care ward. The EMI levels, compared to existing levels, were not considered excessive. All of the above data are analyzed on the basis of life-cycle costing. The analysis is presented on sets of curves relating the cost-effective price of a ballast to the cost of electrical energy.

30820 (NP—1904010) Residential site design and energy conservation. Part 1: general report. (Ministry of Housing, Ottawa, Ontario (Canada)). Jan 1981. 158p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE81904010.

The purpose of this study is to determine the energy costs that can be saved by a subdivision design format related to energy conservation that is reasonably acceptable in marketing and aesthetic terms. The site chosen for the study is one of 163 acres (65.2 hectares) in Guelph. Six subdivision layouts are designed to densities ranging from 6.5 to 13.6 units per gross acre (1058 to 2232 units) or 16.25 to 34 units per gross hectare. Hourly radiation temperature, and wind characteristics for a year constitute the local climate data base. Six house types (from detached to apartment units) and seventeen basic house designs (mostly picked at random) are used. The method for calculating the net heat load and an analysis of the results are presented. A study was made of the possible transportation energy consumption in the subdivision. Development costs of the area are discussed. The fiscal impact of the subdivision on the municipal and school finances is briefly analyzed. Total annual heat loads for alternative plans adjusted to the energy source and the related furnace efficiency are given. The study shows that by way of the selection of the more energy efficient traditional house designs, orientation of buildings to maximize solar transmission, and landscaping to reduce the effect of wind, there is a possible residential space heating energy saving of up to 20% for a low density housing development. (MCW)

30821 (ORNL/CON—75) Effect of forced ventilation on house infiltration. Levins, W.P. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 40p. NTIS, PC A03/MF A01. Order Number DE81029118.

Tests were conducted over a period of 18 months at a house near Knoxville, Tennessee, to determine the effect of forced ventilation on the house infiltration rate. An outside-vented electric dryer was used as the power vent. The testing was carried out during a variety of weather conditions. The tracer gas technique using sulfur hexafluoride was employed to measure infiltration rates. A correlation equation was developed based on measured data that relates the change in the house infiltration rate to the dryer vent rate. The correlation equation has the form of an inverse exponential curve that shows a greater increase in the infiltration rate of a tightly constructed house than of a loosely constructed house. Calculations were made for 17 cities across the United States showing the effect of dryer location on house energy consumption.

30822 (PB—81-114514) Draft program of research and development on energy conservation in small and medium sized oil fired boilers. Rasmussen, P.H. (Swedish Council for Building Research, Stockholm). 1980. 51p. NTIS, PC A04/MF A01.

This investigation is concerned with the economics and performance of smaller oil-fired heating installations. The objective is to identify feasible and reasonable fuel conservation measures and to propose research and investigatory work which can provide a basis for decisions on concrete measures in individual installations.

30823 (PB—81-123911) Guidelines for energy management and control systems for VA (Veterans Administration) facilities. Volume I. Final report. (Enviro-Management and Research, Inc., Washington, DC (USA)). Jun 1979. 275p. NTIS, PC A12/MF A01.

Energy management and control (EMC) systems have the potential of providing substantial energy and energy cost savings in VA hospitals. This report contains specific guidelines that were developed subsequent to on-site inspection of ten hospitals which already had installed, or which were in the process of installing EMC systems.

30824 (PB—81-126013) Safety and energy conservation potential of retrofit devices for gas-fired appliances: Volume I. Final report, August 1977-December 1979. Adams, D.E. (Calspan Corp., Buffalo, NY (USA)). Dec 1979. 223p. NTIS, PC A10/MF A01.

This report gives the results of laboratory and field tests which evaluated the safety and energy conservation potential of approximately 20 add-on devices and modifications to gas-fired heating equipment. The results indicate that furnace derating and the use of electrically-operated automatic vent dampers can, on the average, reduce gas consumption for space heating by 8.1 percent and 6.7 percent respectively. The report emphasizes the importance of safety in retrofit applications, and the need for utilization of qualified contractors.

30825 (PB—81-126021) Safety and energy conservation potential of retrofit devices for gas-fired appliances: Volume II. Final report, August 1977-December 1979. Adams, D.E. (Calspan Corp., Buffalo, NY (USA)). Dec 1979. 108p. NTIS, PC A06/MF A01.

This study covered laboratory and field tests which evaluated the safety and energy conservation potential of approximately 20 add-on devices and modifications to gas-fired heating equipment. Volume 2 includes test site selection guidelines, installation and maintenance guidelines, and data acquisition guidelines.

30826 (SAI—444-80-278-LJ/Rev.) Heat pump on-off capacity control and defrost performance tests using demand and time-temperature defrost controls. (Science Applications, Inc., La Jolla, CA (USA)). 27 Apr 1980. Contract AC01-79CS10757. 87p. NTIS, PC A05/MF A01.

Two heat pumps were tested at several on-off cycles to determine performance at part load conditions. Also, the heat pumps were tested at full capacity under frost buildup conditions with both time-temperature and demand deforst controls. The objectives were to develop correlations for use in seasonal performance models. For on-off cycling, it was found that COP as a fraction of steady state COP could be predicted with power law relationships involving capacity as a fraction of steady state capacity. Frost buildup occurred in a two step process, with initial gradual frost buildup to a transition point followed by rapid frost buildup until a defrost cycle was initiated. Heat capacities under frost buildup conditions were predicted as a function of outdoor air temperature and difference between specific humidity of the outtdoor air and specific humidity of saturated air at outdoor coil temperatures.

30827 (SAI—444-80-423-LJ) Evaluation of energy-consumption savings due to setting standards for humidifiers and dehumidifiers. Topical report subtask 7.1: consumers product minimum energy efficiency standards program. (Science Applications, Inc., La Jolla, CA (USA)). 7 Jul 1980. Contract AC03-79CS10757. 11p. NTIS, PC A02/MF A01.

The potential energy savings due to the imposition of minimum energy efficiency standards for humidifiers and dehimidifiers are documented. This information on energy savings along with DOE benchmarks is tabulated. It is shown that for either humidifiers or dehumidifiers, standards will not result in aggregate savings of greater than 8.4×10^8 kWh per year, and thus the standards are

not justified. Furthermore, the burden placed on the manufacturers and the increased cost to the consumer due to compliance will probably not be offset by the energy savings. Sources of information and the assumptions made in the energy saving predictions are documented. (MCW)

30828 **(SAI—444-80-479-LJ) User's manual for the DOEHPE (DOE Heat Pump Efficiency) computer code. Topical report substask 8.4.** (Science Applications, Inc., La Jolla, CA (USA)). 13 Aug 1980. Contract AC03-79CS10757. 18p. NTIS, PC A02/MF A01. Order Number DE81021562.

This manual documents the computer code used to generate air source heat pump seasonal and annual performance factors. The computer code DOEHPE calculates these factors as well as annual energy consumption for each of the six climatic regions in the US. The program uses the standard measurements (rating points) of heat pump capacities and power inputs as input data as well as heat pump description data. The system description data is used to differentiate between single-speed and dual-speed compressors, as well as to account for differnt degradation coefficients, modes of operation (cooling and heating, or heating only), and defrosting systems (demand or time-temperature control). For dual speed compressor models, the code differentiates between compressors which cycle on and off at high speed and compressors which alternate between low and high speeds to meet the building heating or cooling loads. DOEHPE also accomodates heat pump systems that do not have an air circulation fan on the indoor coil as part of the system.

30829 **(SERI/TP—721-1316) Electric coheating experiment to determine the heat-loss coefficient of a double-envelope house.** Ortega, J.K.E.; Anderson, J.V.; Connolly, J.M.; Bingham, C.E. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1981. Contract AC02-77CH00178. 7p. (CONF-810925—11). NTIS, PC A02/MF A01. Order Number DE81027937.

From 6. national passive conference; Portland, OR, USA (8 Sep 1981).

An electric coheating experiment was conducted on a double-envelope house in Arvada, Colorado, to determine the total heat loss coefficient (UA) of the double-shelled structure, as well as the heat loss coefficients of the inner and outer shells. Electric coheating is fairly well established as an experimental method for determining the total heat loss coefficient in conventional residential buildings. However, special problems are introduced with passive and double-envelope buildings. A new methodology was developed to meet these problems. That methodology and the results of the experimental investigation are presented and discussed.

30830 **(SERI/TP—722-1355) Ground-coupled cooling in hot, arid regions.** Bircher, T.L. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1981. Contract AC02-77CH00178. 6p. NTIS, PC A02/MF A01. Order Number DE81028357.

Based on results from a computer simulation, the impact of ground-coupling on the cooling loads of desert buildings is evaluated. Detailed two-dimensional thermal networks were devised and analyzed by the computer program SPICE. A series of parametric studies was conducted, first to assess the thermal effects of variation in several parameters and second to derive a ground-coupling design with minimal loads. A detailed comparison of the ground-coupling design with a similar high-mass well-insulated surface building was then made using results of monthly heat balance computations. Results of the parametric studies indicated that the building's annual performance is sensitive to the amount and orientation of fenestration, to the soil depth around the building, and to the amount and location of insulation. However, varying the soils's thermal properties and berming as opposed to burying the building to the same depth had little influence on annual performance. In comparing the above-grade and ground-coupled cases, the reduction in cooling for the latter was 40%, with reduced infiltration and lower heat flows through the wall and floor sharing equally in this decrease. For both the above- and below-grade situations, internal heat generation ranked first among the contributors to the cooling loads with 35% and 58%, respectively.

30831 **(SERI/TR—721-1119) Appliance efficiency and the solar building.** Swisher, J. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1981. Contract AC02-77CH00178. 30p. NTIS, PC A03/MF A01. Order Number DE81029073.

This report examines energy use in residential appliances. Current appliance energy use is evaluated and technologically feasible improvements are studied. A typical set of household appliances is developed, and modified by three classes of efficiency improvements. Significant energy saving potential is found in all major appliance energy uses, with the largest savings in water heaters and refrigerators. Costs of the improvements are relatively low, providing short payback times. The effects of the improvements on building thermal loads and electricity demand profiles are also examined.

30832 **Building air change rate and infiltration measurements.** Hunt, C.M.; King, J.C.; Trechsel, H.R. (eds.). Philadelphia, PA; American Society for Testing and Materials (1980). 195p. (ASTM-STP—719; CONF-780344—).

From Symposium on air infiltration and air change rate measurements; Washington, DC, USA (13 Mar 1978).

Separate abstracts have been prepared for 10 papers presented at the symposium. One paper had previously appeared in the appropriate DOE Energy Data Base. (MCW)

30833 **Air infiltration: a review of some existing measurement techniques and data.** Hunt, C.M. (National Bureau of Standards, Washington, DC). pp 3-23 of Building air change rate and infiltration measurements. Hunt, C.M.; King, J.C.; Trechsel, H.R. (eds.). Philadelphia, PA; American Society for Testing and Materials (1980).

From Symposium on air infiltration and air change rate measurements; Washington, DC, USA (13 Mar 1978).

This paper reviews the state of the art in the measurement of ventilation and air infiltration. It considers tracer gas techniques and discusses some of the tracer gases used as well as some of the potential sources of error. It also discusses fan pressurization-evacuation procedures for measuring building tightness and compares fan and tracer measurements. It discusses the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) crack method. It also considers a number of factors influencing infiltration rates and finally reviews a few of the empirical equations that have been developed to correlate infiltration rate with wind velocity and inside-outside temperature difference.

30834 **Field studies of the air tightness of residential buildings.** Wang, F.S. Sr. (Dow Chemical Co., Midland, MI); Sepsy, C.F. pp 24-35 of Building air change rate and infiltration measurements. Hunt, C.M.; King, J.C.; Trechsel, H.R. (eds.). Philadelphia, PA; American Society for Testing and Materials (1980).

From Symposium on air infiltration and air change rate measurements; Washington, DC, USA (13 Mar 1978).

The two major techniques utilized to either quantify the air infiltration rate or characterize the air leakage of a house (the tracer gas technique and the induced pressure technique) are discussed. Each one has its advantages or drawbacks in practice. They do compliment each other in situations where a large number of houses need to be measured. A typical case is presented here to show that both techniques were applied to the same group of houses. The measured air infiltration rates from the tracer gas technique, and equivalent air leakage area from the induced pressure technique do show good agreement in concluding the air tightness of these houses. The existence of such air infiltration rate differences was also detected through the energy consumption test conducted among the same group. Some of the practical aspects of these two approaches are also presented.

30835 **Air leakage measurements by the tracer dilution method: a review.** Lagus, P.L. (Systems, Science, and Software, La Jolla, CA). pp 36-49 of Building air change rate and infiltration measurements. Hunt, C.M.; King, J.C.; Trechsel, H.R. (eds.). Philadelphia, PA; American Society for Testing and Materials (1980).

From Symposium on air infiltration and air change rate measurements; Washington, DC, USA (13 Mar 1978).

The tracer dilution method used to infer air leakage rates is discussed. There exists no perfect or ideal tracer. The choice of

tracer gas is dependent upon the characteristics inherent in the measurement, the structure being measured, and in the relative familiarity of the experimenter with a variety of experimental techniques. The various gases that have been used for performing tracer dilution measurements in the past are presented along with their methods of measurement. In addition, the basic experimental methodology for performing a tracer dilution measurement utilizing any tracer is discussed. The limitations and advantages of the method are described and recommendations for its use are made. The need for standard test methodology is explored with an emphasis on the ability to produce and provide data that can be intercompared at some later time. An uncertainty analysis of the method is provided.

30836 **Low-cost method for measuring air infiltration rates in a large sample of dwellings.** Grot, R.A. (National Bureau of Standards, Washington, DC). pp 50-59 of Building air change rate and infiltration measurements. Hunt, C.M.; King, J.C.; Trechsel, H.R. (eds.). Philadelphia, PA; American Society for Testing and Materials (1980).

From Symposium on air infiltration and air change rate measurements; Washington, DC, USA (13 Mar 1978).

A method for collecting air infiltration data in a large sample of dwellings is presented. The method consists of a tracer gas dilution technique employing air sample bags that are analyzed in a central laboratory. The method will be applied to a Community Services Administration optimal weatherization demonstration in approximately 300 dwellings on 16 sites throughout the United States. The method will yield air exchange rates under typical heating season conditions for each dwelling in the demonstration. Preliminary data on air infiltration rates in low-income housing in Portland, Maine are presented.

30837 **Infrasonic measurement of building air leakage: a progress report.** Card, W.H.; Sallman, A.; Graham, R.W.; Drucker, E.E. (Syracuse Univ., NY). pp 73-88 of Building air change rate and infiltration measurements. Hunt, C.M.; King, J.C.; Trechsel, H.R. (eds.). Philadelphia, PA; American Society for Testing and Materials (1980).

From Symposium on air infiltration and air change rate measurements; Washington, DC, USA (13 Mar 1978).

This research compares a new infrasonic method with the conventional blower method for determining the composite effective size of all the air-leakage passages in a house or apartment. In the frequency range used (0.1 to 7 Hz) small buildings are characterized mainly by one acoustic capacitance and one nonlinear leakage resistance. Infrasonic apparatus comprising a motor-driven source having known output, a sensitive pressure pickup, and an electronic signal processor has been constructed and used to measure leakage from several apartments and a house. Under field conditions the results of the infrasonic and blower measurements agree within a factor of two or three. Since the infrasonic system requires no through-the-wall blower vent or pressure taps, it is easier to set up than a blower system.

30838 **Air infiltration reduction through retrofitting.** Harrje, D.T.; Mills, T.A. Jr. (Princeton Univ. NJ). pp 89-106 of Building air change rate and infiltration measurements. Hunt, C.M.; King, J.C.; Trechsel, H.R. (eds.). Philadelphia, PA; American Society for Testing and Materials (1980).

From Symposium on air infiltration and air change rate measurements; Washington, DC, USA (13 Mar 1978).

This paper documents and compares the air infiltration levels experienced in five Twin Rivers townhouses before and after retrofit. The technique used to measure air infiltration rates was the tracer gas method, which relied upon automated equipment. Weather data as well as 5-min interval air infiltration measurements were used in the comparisons. Analysis techniques included multiple regression, polar plotting, stemleaf plotting, and detailed comparisons of infiltration rates as influenced by temperature differences inside-to-outside the dwelling. The results indicate that: the retrofitted townhouses are noticeably less sensitive to wind direction, showing little or no increase in infiltration when the wind directly impinges on building surfaces; the post-retrofit infiltration rates average 36% less than the preretrofit data, with individual houses experiencing as much as a 48% decrease; and basement and attic retrofitting appear to be very influential in achieving the greatest reductions in air infiltration rates.

30839 **Wintertime infiltration rates in mobile homes.** Goldschmidt, V.W. (Purdue Univ., W. Lafayette, IN); Leonard, R.G.; Ball, J.E.; Wilhelm, D.R. pp 107-124 of Building air change rate and infiltration measurements. Hunt, C.M.; King, J.C.; Trechsel, H.R. (eds.). Philadelphia, PA; American Society for Testing and Materials (1980).

From Symposium on air infiltration and air change rate measurements; Washington, DC, USA (13 Mar 1978).

Air infiltration in mobile homes is discussed. A field test setup including two unoccupied mobile homes is described. The facility permits a measure of weather, consumption, infiltration rate, and surface temperatures. Data are now presented comparing the winter performance of the two mobile homes. The homes are identical on all counts except that one is treated with a special sheathing board while the other is caulked. The data indicate a general parabolic dependence of infiltration on wind (and a linear dependence on temperature difference) with consistently lower values of infiltration rate for the board-sheathed home than for the caulked home.

30840 **Moisture interactions in light-frame housing: a review.** Schaffer, E.L. (Dept. of Agriculture, Madison, WI). pp 125-143 of Building air change rate and infiltration measurements. Hunt, C.M.; King, J.C.; Trechsel, H.R. (eds.). Philadelphia, PA; American Society for Testing and Materials (1980).

From Symposium on air infiltration and air change rate measurements; Washington, DC, USA (13 Mar 1978).

Though airchange or infiltration can significantly affect energy use, altering interior moisture can influence energy use as well as other performance characteristics. An assessment of the moisture interaction is made as related to health and comfort of the occupants, fire safety, durability and maintainability, and design and construction of light-frame housing. A discussion of significant interactions includes shortcomings and recommendations.

30841 **Residential air pollution levels: observation and data interpretation.** Moschandreas, D.J.; Stark, J.W.C.; McFadden, J.E.; Morse, S.S. (GEOMET, Inc., Gaithersburg, MD). pp 144-152 of Building air change rate and infiltration measurements. Hunt, C.M.; King, J.C.; Trechsel, H.R. (eds.). Philadelphia, PA; American Society for Testing and Materials (1980).

From Symposium on air infiltration and air change rate measurements; Washington, DC, USA (13 Mar 1978).

A program to characterize the air quality in the residential environment is undertaken. The generation of the data base, the interpretation of the data, and the formulation and application of an indoor-outdoor numerical model are discussed. Pollutant concentrations are sampled in three indoor locations and one outdoor location. Instantaneous readings are obtained for CO, NO, NO_2, O_3, SO_2, THC, CH_4, and CO_2; 24-h averages are monitored for total suspended particulate (TSP) and respirable suspended particulate (RSP) matter, sulfates, nitrates, lead and organics; aldehydes are sampled on a 4-h basis. In addition, the meteorological conditions both indoors and outdoors are measured, and the air exchange rate of each residence is experimentally determined. Elemental analysis is performed by proton-induced X-ray emission (PIXE). Finally, the kilowatt hours for heating, cooking, and alternate current; the furnace efficiency; structural specifications; and other energy parameters are measured. The objective of this project is to develop causal relationships between the energy conservation measures-indoor (residential) air pollution concentrations, and health effects. Data analysis shows that the national ambient standards have been violated in the indoor residential environment for two pollutants, ozone and nonmethane hydrocarbons. Additionally, the American Society for Heating, Refrigerating, and Air-Conditioning Engineers' (ASHRAE) recommended indoor air pollution standards are violated by the following pollutants: carbon dioxide, total suspended particulate matter, and aldehydes. A numerical model relating indoor and outdoor air pollution levels has been developed for the project. The model has been validated with the large data base sampled in the field studies. A series of numerical simulations indicate that

under certain conditions energy conserving measures will increase the indoor air pollution levels.

30842 Significance of air infiltration on building energy conservation design, standards, and codes. Ross, H.D. (Dept. of Energy, Washington, DC). pp 153-161 of Building air change rate and infiltration measurements. Hunt, C.M.; King, J.C.; Trechsel, H.R. (eds.). Philadelphia, PA; American Society for Testing and Materials (1980).

From Symposium on air infiltration and air change rate measurements; Washington, DC, USA (13 Mar 1978).

Air infiltration in residences accounts for 30 to 75% of the heating load, and present design procedures in commercial buildings result in excessive amounts of controlled fresh air introduction to offset air exfiltration losses. Simulation studies on retrofit potential of residences reveal that, while portions of the building heating and cooling loads can be reduced substantially using cost-effective techniques, air infiltration remains a dominant factor in the loads. With the advent of a priority status for energy conservation, many new standards have been developed. These standards have been of three primary natures: prescriptive, component performance, and performance. Because new residential designs are making buildings tighter, with less air infiltration, three new standards are necessary to follow the trend in design. These standards are: (1) the use of pressurization-evacuation test methods to set a construction quality performance standard, (2) the use of ducted outside air with heat recovery for fresh air introduction to super-tight residences, and (3) the use of ducted outside air to fossil-fuel burning units for combustion purposes.

30843 (DOE/CS/20102—T1) Energy-saving potential of hotel-room energy-control systems. (Tennessee Univ., Knoxville (USA). Energy, Environment and Resources Center). [nd]. Contract AS05-76CS20102. 81p. NTIS, PC A05/MF A01. Order Number DE81028376.

Devices and systems available to the lodging industry which can automatically adjust thermostat settings and deenergize lighting and appliance circuits when the guest is out of the room are discussed. The objective of this project is to evaluate the energy saving potential of such devices. The program plan to evaluate the devices is described in Chapter 2. The results of the investigation of a number of systems and properties is contained in Chapter 3; the collection of information for prospective purchasers of such equipment is in Chapter 4. Results and conclusions are presented in Chapter 5. Appendix I lists guest-controlled room energy control systems; appendix II lists front-desk controlled room energy control systems; appendix III lists some specific controller installations in specific hotels. Appendix IV presents 8 case histories (tabulated data) on energy consumption in hotels. Appendix V presents an example calculation of the potential savings with room energy controllers. (MCW)

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REFER ALSO TO CITATION(S) 30864, 30893

30844 (ANL/CNSV-TM—72) Heavy-duty engines analysis, Study 1: heavy-duty truck performance and markets. Knorr, R.E. (Argonne National Lab., IL (USA)). Jun 1981. Contract W-31-109-ENG-38. 43p. NTIS, PC A03/MF A01. Order Number DE81026714.

This report provides information on the physical characteristics, performance, cost, and operating environment of heavy-duty trucks in the United States. The unprecedented changes in the trucking industry in the 1970s, which affected both the carriers and manufacturers, are also described. These include issues on size, weight, deregulation, low level of investment, and usage characteristics of the fleet.

30845 (DOE/CS/50189—T1) Energy-economy study methods and transit cases. Final report. Henderson, C.; Ellis, H.T. (SRI International, Menlo Park, CA (USA)). Jul 1981. Contract AC03-80CS50189. 89p. NTIS, PC A05/MF A01. Order Number DE81027485.

The purpose of this report is to describe energy economy study methods that are now available for practical use. The report discusses methods of estimating energy demands in Chapter II. Three heavy rail transit systems and two bus systems (Chapters III to VII) are described in terms of their development history, physical characteristics, operations, service, and energy demands. Estimates are made for the direct and indirect energy demands for the systems and energy economy studies of hypothetical alternatives for operations, equipment, or facilities are presented for the following systems: PATH (Port Authority Trans-Hudson) rail system; BART (Bay Area Rapid Transit District) rail system; AC Transit (Alameda-Contra Costa Transit District) bus system; Washington Metropolitan Area Transit Authority (WMATA) Metrobus and Metrorail systems. Chapter VIII discusses a number of opportunities to conduct energy economy studies, and presents quantitative data for three comparisons of hypothetical alternatives. Some infomation from actual settings was used. (MCW)

30846 (DOE/CS/51176—T9) Railroad energy study: regulation. Volume 2: rail-passenger transportation. (SRI International, Menlo Park, CA (USA)). Mar 1977. Contract AC03-76CS51176. 26p. NTIS, PC A03/MF A01.

The objectives of the study are to: provide a current, comprehensive, and accurate data base of railroad economic activity and energy consumption; describe planned and postulated expansion and the time frame of future developments; identify research and development needs related to improvements in energy utilization; and provide data that the federal government may use to determine its future role. This report identifies the institutions and reviews the general arrangements under which rail passenger transportation services are delivered by railroads and transit agencies in the United States. Attention is given to the many and varied agencies concerned with regulating, planning, constructing, equipping, operating, fare setting, financing, and subsidizing rail passenger services. (MCW)

30847 (DOE/CS/51176—T11) Railroad energy study: efficiency improvements. Volume I. Freight railroading. (Stanford Research Inst., Menlo Park, CA (USA)). Mar 1977. Contract AC03-76CS51176. 75p. NTIS, PC A04/MF A01. Order Number DE81026107.

The objectives of the study are to: provide a current, comprehensive, and accurate data base of railroad economic activity and energy consumption; describe planned and postulated expansion and the time frame of future developments; identify research and development needs related to improvements in energy utilization; and provide data that the Federal government may use to determine its future role. The study is organized into 4 tasks. This reseach Task III catalogues energy-conserving technological and operational improvements to freight railroading and estimates capital investment, maintenance, life cycle, and operating costs for each improvement where appropriate. The maximum expected improvements in railroad fuel consumption on a national basis are desribed. Energy-saving and operational improvements are reviewed and potential model shifts to railroad freight are discussed. (MCW)

30848 (DOE/CS/51176—T12) Railroad energy study: description of rail transportation in the United States. Volume I. Freight railroading. (Stanford Research Inst., Menlo Park, CA (USA)). Jan 1977. Contract AC03-76CS51176. 162p. NTIS, PC A08/MF A01. Order Number DE81024166.

The objectives of the study are to: provide a current, comprehensive, and accurate data baseline of railroad economic activity and energy consumption; describe planned and postulated expansion and the time frame of future developments; identify research and development needs related to improvements in energy utilization; and provide data that the Federal government may use to determine its future role. Volume I comprises a summary; a history of the railroads that provides historical perspective for the current structure and practices of the industry; a description of the freight railroad industry, facilities, and equipment; a description of freight railroad costs and how they vary with the volume and nature of activities; and a discussion of energy use by freight railroads. (MOW)

30849 **(DOE/CS/51176—T25) Program plan: energy study of rail transportation.** Moon, A.E. (Stanford Research Inst., Menlo Park, CA (USA)). 24 May 1976. Contract AC03-76CS51176. 25p. NTIS, PC A02/MF A01. Order Number DE81025953.

The purpose of this document is to present a program plan for the Energy Study of Railroad Transportation. The report contains summary descriptions of tasks and subtasks and schedules and manpower estimates for the project. Major tasks for the rail freight energy study are a current industry description; analysis of regulations and tariff impacts on the industry; efficiency improvements; and industry future. Major tasks for the rail passenger study are a current industry description; federal government regulations and tariff structure; effectiveness improvements; and industry future. (MCW)

30850 **(DOE/EIA/10085—T1(Pt.4)) National Interim Energy-Consumption Survey. Part IV. Transportation panel. Including Appendices A through C.** (Response Analysis Corp., Princeton, NJ (USA)). 1981. Contract AC01-79EI10085. 135p. (DOE/EIA—0295/4). NTIS, PC A07/MF A01. Order Number DE81026079.

The activities of the transportation panel, a monthly survey in which a national sample of households are asked to keep a record of all fuel purchased for vehicles used by the household, are summarized. The fuels of interest are gasoline, diesel fuel, and gasohol. Eligible vehicles include automobiles, station wagons, passenger and cargo vans, motor homes, pickups and other small trucks, and jeeps. A pretest was conducted April and May 1979 to determine the extent to which households respondents were willing to keep records of their gasoline purchases and to provide guidance on the best ways to request these data. Activities of this period are described. The activities of the transportation panel from June to October 1979, are summarized. Additional information on the transportation panel presented in Appendices A, B, and C is: transportation panel design (issues and comments); data collection materials; data files, coding instructions, and forms. (MCW)

30851 **(DOE/EIA/10085—T1(Pt.5)) National Interim Energy-Consumption Survey. Part V. Transportation panel. Appendices D through H.** (Response Analysis Corp., Princeton, NJ (USA)). 1981. Contract AC01-79EI10085. 194p. (DOE/EIA—0295/5). NTIS, PC A09/MF A01. Order Number DE81027604.

Five appendices to a report on the activities of the transportation panel, a monthly survey in which a national sample of households are asked to keep a record of all fuel purchased for vehicles used by the households, are presented. Gasoline, diesel fuels, and gasohol for automobiles, station wagons, passenger and cargo vans, motor homes, pickup and other small trucks, and jeeps are of interest. The following are presented: an outline of the operating environment of the IBM/3033 computer and the programming strategy that was used for development of the transportation panel; an outline of each transportation panel program; specific EDIT enhancements for the transportation panel; the TPEDIT 1 and TPEDIT 2 driving tables, TPVCODES and TPRELATE with explanation and translation; and a description of the editing checks using vehicle miles per gallon with examples. Vehicle completeness and data imputation are discussed. (MCW)

30852 **(DOE/SF/76003—T10) Technical analysis support for transportation systems to promote energy conservation.** (Aerospace Corp., El Segundo, CA (USA). Environment and Energy Conservation Div.). 20 May 1976. Contract AT03-76SF76003. 60p. NTIS, PC A04/MF A01. Order Number DE81027039.

A program is described involving the following tasks: technical support of on-going research and development programs in energy-efficient transportation systems; analysis for the future commercialization of transportation technologies; new concepts programs support; technical evaluation of new concepts, inventions, and ideas; and assessment of technological and other factors on the implementation and utilization of transportation in the US. The program definition, the details of efforts within the task areas, and the programmatic approach for conducting the work are delineated. (MCW)

30853 **(PB—81-111924) Passenger car fuel economy: EPA and road. A report to the Congress. Final report.** Murrell, D. (Environmental Protection Agency, Ann Arbor, MI (USA). Motor Vehicle Emission Lab.). Sep 1980. 306p. NTIS, PC A14/MF A01.

In accordance with the National Energy Conservation Policy Act of 1978, Title IV, Part 1, section 404, this report has two objectives: (1) to determine the degree to which 'EPA MPG' figures used in fuel economy labels and gas mileage guides provide realistic estimates of average in-use fuel economy, and (2) to provide a technical basis for revising, as necessary, the label and guide MPG figures to better agree with average in-use fuel economy, and, further, to provide information on the degree to which specific in-use fuel economy influences can cause departures from the standardized label and guide fuel economy figures.

30854 **(PB—81-119356) Comparison of owner perceived and EPA measured fuel economy. Technical report.** Rutherford, J.A. (Environmental Protection Agency, Ann Arbor, MI (USA)). Aug 1977. 42p. NTIS, PC A03/MF A01.

Data from 1099 vehicles (model years 1974-1976) in the Fiscal Year 1975 Emission Factor Program are utilized in examining the differences between owner estimated fuel economies and fuel economies derived from EPA tests on the same in-use, consumer-owned vehicles. The discrepancies are examined in terms of absolute differences and percentages. Various vehicle classification, maintenance and utilization factors are investigated to determine their relationship to these discrepancies. The agreement in ranking of vehicles on fuel economy between owner determined and EPA determined economies is also investigated.

30855 **(PB—81-121063) Comparison of hot to cold tire fuel economy. Technical report.** Torres, M.; Burgeson, R.N. (Environmental Protection Agency, Ann Arbor, MI (USA)). Dec 1978. 13p. NTIS, PC A02/MF A01.

As part of a comprehensive tire rolling resistance measurement program, a tire study was conducted on 33 different sets of tires at ambient temperature (approximately 75F). Each set of tires was installed on the rear two wheels of a fully warmed-up vehicle. The vehicle was then driven over an FTP driving schedule on a single large-roll dynamometer and the emissions and fuel economy values were determined for each phase of the schedule. The fuel economy changes due to tire warm-up are summarized and analyzed. In addition, the effect of tire type, size and manufacturer on the fuel economy values are investigated. Finally, the effect of tire warm-up on tire rolling resistance is discussed.

30856 **(PB—81-121956) Comparison of EPA measured fuel economy with the mileage guide. Technical report.** Rutherford, J.A. (Environmental Protection Agency, Ann Arbor, MI (USA)). Aug 1977. 24p. NTIS, PC A02/MF A01.

Data from 842 vehicles (model years 1975-1976) in the Fiscal Year 1975 Emission Factor Program are utilized to examine the differences between fuel economies derived from EPA tests on in-use, consumer owned vehicles and the appropriate values for each vehicle which appear in the Gas Mileage Guides. The discrepancies are examined in terms of absolute differences and percentages. Various vehicle classification, maintenance and utilization factors are investigated to determine their relationship to these discrepancies. The agreement in ranking of vehicles on fuel economy between EF and guide determined economies is also investigated.

30857 **(PB—81-801334) Car pools, 1970-December 1980 (citations from the NTIS data base). Report for 1970-December 1980.** Kenton, E. (National Technical Information Service, Springfield, VA (USA)). Dec 1980. 189p. NTIS PC N01/MF N01.

Studies are presented of the feasibility, methodology, and benefits of coordinated and shared automobile usage, or carpooling, in urban areas. The most important transportation-related problems to be dealt with in cities today are traffic congestion, air pollution and fuel shortage. Reports show that these are alleviated by carpooling. Carpooling and also vanpooling, or ridesharing in general, not only increase the efficiency of the public transportation system but contribute as well towards fuel conservation, i.e. energy conser-

vation. Preferential lane treatments in many cities (priority lanes) for buses and carpools or high-occupancy vehicles is presented, ridesharing commuter services coupled with brokeage service is also discussed. Other facets of carpooling such as employer-preferential treatment of carpoolers, carpool-matching services, incentives to gain motorists' support, and the like is presented. (This updated bibliography contains 182 citations, 29 of which are new entries to the previous edition.)

30858 **(UCRL—86543) Ridesharing and the database management system.** Taasevigen, D. (Lawrence Livermore National Lab., CA (USA)). Aug 1981. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01. Order Number DE81028651.

Lawrence Livermore National Laboratory has operated a ridesharing program since 1977. As the volume of recordkeeping and information tracking for the program became more extensive, the need for an easily altered and operated database system became apparent. The following report describes the needs of the ridesharing program and how our database management system answers those needs.

30859 **(UMTA-RI—06-0007-80-1) Life-cycle costing for procurement of small buses.** Winslow, B.; Morrow, R.; Carbone, R.; Cross, E. (Gill Associates, Inc., Washington, DC (USA)). Aug 1980. 80p. NTIS. Order Number DE81903589.

Life-cycle costing is a technique for objectively incorporating the costs of ownership of equipment in the procurement selection process. It is an accepted alternative to low initial price for selection of transit rolling stock. To be used in procurement, the evaluation procedure must be described in the bidders' information and the procedure and data used must be based on the established relationship to the costs of owning and operating the equipment. Forecasts of future costs for maintenance and fuel may be based on experience obtained either in a testing program or final normal revenue service operation. Realistic assessments of future operating environment and requirements, and consistent applications of procedures and cost parameters, tend to minimize the risk that errors in estimates of future costs will result in an incorrect selection. Use of life-cycle costing reduces the probability that low-priced, but inappropriate, vehicles will be selected for transit service and encourages vendors to incorporate cost-effective improvements in tendered vehicles.

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REFER ALSO TO CITATION(S) 30227, 30244, 30800

30860 **(ANL/CNSV-TM—67) Oasis code application to proposed Argonne National Laboratory cogeneration plant.** Bingman, D.J.; Leslie, N.P. (Argonne National Lab., IL (USA)). Jun 1981. Contract W-31-109-ENG-38. 135p. NTIS, PC A07/MF A01. Order Number DE81025869.

A computer program, OASIS (Optimization and Simulation of Integrated Systems), has been developed by Argonne National Laboratory to provide detailed representations of the processes and operating conditions in central plants. It contains an extensive library of generic component subroutines that model representative equipment using part-load performance curves. New technologies may be modeled by adding FORTRAN written subroutines in the job input stream. The equipment performance and economic data already included are easy to modify, so that almost any plant configuration and set of operating conditions may be modeled. The quasi-steady-state simulation is based on user-defined or optimal operation in response to user-supplied demands. The use of OASIS is described for an evaluation of the proposed cogeneration plant at Argonne National Laboratory.

30861 **(BSDF—38-4Q-80) Evaporation by mechanical vapor recompression. Final report, September, 1979 - October 31, 1980.** Iverson, C.H.; Coury, G.E.; Fischer, J.H. (Beet Sugar Development Foundation, Fort Collins, CO (USA)). 1980. Contract AC03-79CS40208. 208p. NTIS, PC A10/MF A01. Order Number DE81022517.

A review of existing technology and application of the mechanical vapor recompression and falling film evaporation in both the sugar and non-sugar industries, and the potential of application to the domestic beet sugar industry is made. Upon assimilating the information gathered, certain design guidelines were established, possible candidate factories for a demonstration project were identified, and a preliminary technical and economic evaluation of the sites was made. The Nampa, Idaho plant of the Amalgamated Sugar Company was selected as the most amenable from the standpoint of technical compatibility, the most attractive on investment and the enthusiasm of the management. Preliminary engineering was done for the Nampa site, permitting a reasonably definitive installed cost estimate to be made. Based upon a synthetic energy balance, the steam savings were calculated and translated into dollars using 1980 fuel costs escalated to 1982 at 12% per year. These efforts generated a gross return on investment calculation of 40.7% based upon fuel savings divided by capital cost. The estimate included adequate instrumentation for the monitoring and measuring of all the process parameters for the purpose of assessing the performance of each component. A complete testing program for accomplishing this evaluation was developed. Additional information is presented in 7 appendices.

30862 (CONF-790346—, pp 16p, Paper 4) **Alternate energy studies in an industrial complex.** Leenhouts, H.D. (Dept. of Energy, Albuquerque Operations Office, NM). 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

The responsibilities of the Albuquerque Operations Office are enumerated with emphasis on its responsibility to conduct industrial activities to promote energy conservation in an attempt to find alternate fuels so as not to deplete the fossil fuel inventory. The first study described involves reducing energy consumption at the facilities. Then the program to convert to alternate energy sources is described. Studies were made dealing with viable technical options for producing process heat, and cogeneration was shown to be the option that could comply with the Power Plant and Industrial Fuel Use Act of 1978. Options considered were: waste heat; wind; hydraulics; geothermal; wood; nuclear; solar; solid waste; RDF; total electric; heat pumps; hydrogen fuel cells; coal (conventional, with cogeneration, gasification, with solid waste or RFD); and fluidized bed. Some options are discussed with emphasis on cogeneration. (MCW)

30863 **(CONF-810812—34) Design and development of a reciprocating low-temperature freon expander.** Hynek, S.J.; Demler, R.L.; Harvey, A.C.; Walker, D.H.; Fuller, H.H. (Foster-Miller Associates, Inc., Waltham, MA (USA)). 1981. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE81028609.

From IECEC conference; Atlanta, GA, USA (9 Aug 1981).

The design and development of a 20-ton refrigeration system to be powered by 140°F waste hot water is described. The system consists of a Rankine cycle driving a reverse-Rankine cycle, integrated in that they share a common working fluid (R-22), a common condenser, and a common crankcase housing the expander and compressor. A reciprocating single-acting counterflow expander provides a combination of high efficiency in the desired capacity range, modularity, and adaptability to existing compressors. Because the temperatures and pressures of the Rankine cycle fell within the design envelope of a standard refrigeration compressor, the compressor and expander could be housed within the same crankcase by converting some of the compressor cylinders to expander cylinders by replacing the cylinder heads. The expander heads incorporate rotary valves which offer high flow coefficients; they permit higher flow areas and more straightforward flow paths than poppet valves. Rotary valve design presents little risk considering the use of compatible oil, the low operating temperatures, and close clearances that are consistent with minimal differential thermal expansion. Valve timing was optimized by a computerized finite difference technique that performed mass and energy balances and calculated flow through the valves as the crankshaft progressed incrementally. This calculation predicted that breathing losses would amount to only 13%.Thermal losses are expected to be minimal, for temperature differences are low and thermal transport properties poor. Mechanical losses are expected to be less than those of an internal combustion engine; m.e.p. is comparable, and the expander cylinder environment is less hostile to the lubricating oil.

30864 (DOE/CS/40004—T11) Conservation RD and D strategy planning. (TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). Nov 1977. Contract AC03-77CS40004. 25p. NTIS, PC A02/MF A01. Order Number DE81017995.

The implications of the National Energy Plan for conservation research, development, and demonstration strategies are explored. The major areas for conservation research, taking into account the new energy use patterns envisioned by NEP, are identified. Five areas discussed for each of the industrial, transportation, and residential/commercial sectors include: major targets for conservation on which the NEP is based; future patterns of consumption resulting from the NEP; conservation programs based on the new consumption patterns; targets for conservation which will facilitate attainment of the NEP goals but which have yet to be included in the NEP strategy; and important areas needing further study. (MCW)

30865 (DOE/CS/40020—T1) Multifrequency factor operations. Final report. (Varigas Research, Inc., Timonium, MD (USA)). Sep 1979. Contract AC03-77CS40020. 140p. NTIS, PC A07/MF A01. Order Number DE81026115.

The potential for energy savings which exists when a factory is operated from multiple frequency electric power is examined. In a previous study it was demonstrated that power hand tools operating from 360 to 400 Hz electric power achieve significant energy savings compared to the currently popular compressed air power tools. Fluorescent lighting and high intensity discharge lighting also are known to be more energy efficient when operated from electric power at frequencies higher than 60 Hz. Because the energy input to lighting and tooling is almost entirely converted to heat in the factory, energy conserved through more efficient tooling and lighting will also influence the heating and air conditioning requirements of the factory. The current study developed quantitative data and methods which permit an engineering assessment of the energy savings potential from multiple frequencies in any specific factory. Incremental energy savings estimates were developed which can be applied to any factory on the basis of the number of square feet in the factory. Areas within the factory at different light levels or with different amounts of tooling can be treated independently. This study was divided into six tasks as follows: 1) energy savings from high frequency tooling, 2) energy savings from high frequency lighting, 3) multifrequency generator/conversion and configurations, 4) methods for including multifrequency savings in cogeneration systems, 5) relative cost requirements, and 6) a field investigation of recent cogeneration installations to determine the compatibility of such systems with multifrequency operations. The report concludes that there are appreciable savings in energy to be realized through multifrequency operations and provides the data and methods required to compute these savings in any specific factory.

30866 (DOE/CS/40021—T1) AGRIMOD: a dynamic simulation model of the US food-production system. Part IV. The computer simulation. Ducot, E.R. (Systems Control, Inc., Palo Alto, CA (USA)). May 1979. Contract AC03-77CS40021. 444p. NTIS, PC A19/MF A01. Order Number DE81029309.

AGRIMOD is a dynamic simulation model of the US food production system for the analysis of (a) the implications of alternative national resource policies on the food supply, (b) the effects of possible natural resource and energy constraints on food supply and prices, (c) the impacts of policies on imports, exports, and reserves, and (d) the effects of technological change. The model consists of seventeen submodels fully integrated through material and information flows into four sectors and three markets. This report is devoted to the design, implementation, and use of the AGRIMOD software that supports this model. The structure of the simulation is described and the data requirements and specification of the simulation input are presented. Then the output of the model is discussed along with the specific considerations for transporting and testing the system software. A listing of the code and data is provided, and the format of the archival version of the complete computer model is documented.

30867 (DOE/CS/40167—T2) Demonstration of energy conservation for multi-deck board dryers: Phase I. Final report. (Johns-Manville Sales Corp., Denver, CO (USA). Research and Development Center). Feb 1980. Contract AC03-78CS40167. 124p. NTIS, PC A06/MF A01.

A study to determine the feasibility of recovering and reusing heat from a large multi-deck dryer used in the manufacture of roof insulation board is described. Pilot scale tests and analyses show that heat recovery designs utilizing several types of heat exchange equipment are feasible. These include: indirect contact air-to-air heat exchangers for preheating combustion air for the dryer furnaces; direct contact air-to-water heat exchangers using water sprays to heat process water; and indirect contact air-to-liquid heat exchangers to heat recirculating liquid in a plant building heating system. (MCW)

30868 (DOE/CS/40215—T2) Energy savings through the use of an improved aluminum reduction cell cathode. Technical progress report, July 1-September 30, 1979. Dorward, R.C.; Payne, J.R. (Kaiser Aluminium and Chemical Corp., Pleasanton, CA (USA)). 29 Nov 1979. Contract AC03-76CS40215. 30p. NTIS, PC A03/MF A01. Order Number DE81024204.

The principal project goal is to develop a Hall cell cathode, which will reduce the specific energy consumption of existing commercial cells by 20 to 25%. The basis of the improvement is the utilization of titanium diboride (TiB_2), a material that is wetted by molten aluminum, as the cell cathode. This provides a stable cathode surface, thereby allowing the cell to be operated at a smaller anode-cathode distance (ACD). Energy savings arise as a result of reduced resistive losses through the cryolite electrolyte. This phase of the program is comprised of three integrated parts: (1) materials characterization; (2) pilot cell testing; and (3) a full-sized cell demonstration. During this quarter emphasis continued on operating the 15KA pilot cell under reduced ACD conditions. The materials evaluation activities also continued, in which fracture morphologies were further characterized. In addition, pilot cell autopsy work on exposed TiB_2 parts was initiated.

30869 (DOE/CS/40327—T1) Development and demonstration of an electric heat pump for waste-heat recovery in industry. Topical report No. 2. Design and analysis report. Moreland, W.C.; Eder, J.S.; Wolfe, R.W. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 30 Mar 1981. Contract AC01-77CS40327. 160p. NTIS, PC A08/MF A01. Order Number DE81028751.

Development of a high temperature heat pump for demonstration of waste heat recovery in industry is described. This report outlines the design of a prototypical unit to be used to recover heat from the vapor effluent of a thermomechanical pulping unit in a paper mill. The output capacity of the unit is 30 x 10^6 Btu/h in the form of process steam delivered at 50 psig with 20°F superheat (318°F). A functional description of the heat pump system is given along with a thermodynamic analysis of the cycle. The various subsystems, controls, and major components are also described and a safety analysis presented. The next step in the program is the procurement of components and fabrication of the heat pump and test loop. A general discussion of the important considerations involved when considering the application of a heat pump to an industrial process is given in Appendix A. Additional information presented in appendices includes an analysis of the hot gas by-pass and control of the intercooler; pressure drops in methanol piping and heat exchangers; and typical liquid nitrogen storage system information.

30870 (DOE/CS/40361—T4(Vol.1)) Temperature control of a continuous, push-type, five-zone, slab-reheating furnace for minimum-fuel usage. Volume I. Text and Appendix A. Purdy, D.J.; Williams, T.J. (Purdue Univ., Lafayette, IN (USA). Purdue Lab. for Applied Industrial Control). Apr 1981. Contract AS07-80CS40361. 281p. NTIS, PC A13/MF A01. Order Number DE81027869.

Thesis.

Investigations are made of temperature control for a continuous, five zone, pusher type, reheat furnace used to heat slabs from the slabbing mill up to the rolling temperature needed for the hot

strip mill. Minimum fuel rates needed to achieve required outlet temperature as a function of production rate are determined. A scheme is presented for carrying out the transition from one steady state operating level to another with a near minimium of fuel usage. A method for using this transition scheme on a process control computer is also presented. A specific objective of this thesis is to suggest a control algorithm for temperature control that minimizes the amount of every consumption during production while that production is subject to various process variations and constraints. Chapter II describes the slab reheat furnace model used for the study. A list of model embellishments and detected errors are presented in addition to the steady state energy balance analysis of the model itself. Chapter III presents the three separate cases of furnace operation and their steady state configurations for eight operating points. Transitions from one of these operating points to another operating point is discussed in Chapter IV. This serves as a basis for the control strategies discussed in Chapter V. The last chapter summarizes the results and conclusions of the study and suggests recommendations for future work. Appendix A includes additional simulation results supplementary to those presented within the report text. Model documentation and computer program listings are presented in Appendix B, C, and D, presented in Volume II. (MCW)

30871 **(DOE/CS/40361—T4(Vol.2)) Temperature control of a continuous, push-type, five-zone, slab-reheating furnace for minimum-fuel usage. Volume II. Program (Appendices B, C, D).** Purdy, D.J.; Williams, T.J. (Purdue Univ., Lafayette, IN (USA). Purdue Lab. for Applied Industrial Control). Apr 1981. Contract AS07-80CS40361. 313p. NTIS, PC A14/MF A01. Order Number DE81027269.

Thesis.

Appendices B, C, and D are presented of a report on investigations for a continuous, five zone, pusher type, slab reheat furnace. Appendix B presents computer documentation of the slab reheating furnace program (33 subroutines). Appendix C presents the slab reheating furnace computer program. Appendix D presents the shape factor program (introduction and program limitations). (MCW)

30872 **(DOE/CS/40361—T6(Vol.1)) Man-machine simulations in industrial systems. Volume I. Narrative.** Davis, G.I.; Buck, J.R. (Purdue Univ., Lafayette, IN (USA). Purdue Lab. for Applied Industrial Control). Dec 1980. Contract AS07-80CS40361. 277p. NTIS, PC A13/MF A01. Order Number DE81027882.

Thesis.

Computer simulation is discussed as an alternative to methodologies upon which ergonomic design of industrial man-made systems has traditionally relied. The development of computer simulation models suitable for representing human operators in industrial process simulations are developed and presented. Use of these models is demonstrated through the use of a particular simulation technique entitled, "Systems Analysis of Integrated Networks of Tasks" (SAINT). This simulation pseudo-language is a combination network modeling and simulation technique designed for the analysis of man-machine systems. A survey of literature relevant to the design and analysis of man-machine systems is provided in Chapter II. Chapter III provides a brief review of the literature on simulation of man-machine systems and describes the SAINT simulation technique used. The development of the human operator models (referred to as Smart SAINT) and their use as a design aid is described in Chapters IV, V, VI. An example of the use of Smart SAINT is shown in Chapter VII where its design aiding is illustrated. Soaking pit scheduling is used to demonstrate how the technique can be used to simulate a complex man-machine system. Chapter VIII presents conclusions based on the research, and recommendations for further research. 166 references. (MCW)

30873 **(DOE/CS/40361—T6(vol.2)) Man-machine simulations in industrial systems. Volume II. Appendices. Report No. 118.** Davis, G.I.; Buck, J.R. (Purdue Univ., Lafayette, IN (USA)). Dec 1980. Contract AS07-80CS40361. 271p. NTIS, PC A12/MF A01. Order Number DE81027870.

Extensive appendices are presented to the thesis on the computer simulation approach to the design and analysis of industrial man made systems. A glossary, data, and background development for operator models are included in Appendices A, B, and C. Appendix D presents information on SAINT (System Analysis of Integrated Networks of Tasks) nodes and subroutines for operator models. This pseudo-language is a combination network modeling and simulation technique designed for the analysis of man-made systems. Appendix E documents the SAINT program for an ingob processing operation and Appendix F changes to basic programs for each experimental demonstration. (MCW)

30874 **(DOE/CS/70001—T3) Potential performance of a Brayton cycle mechanical heat pump.** Wurm, J.; Staats, W.R.; Curran, H.M.; Overman, J.P. (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1977. Contract AM03-76CS70001. 27p. NTIS, PC A03/MF A01. Order Number DE81023968.

The potential performance of a conventional (single phase, ideal gas) Brayton cycle was evaluated. The basic, nonregenerative, ideal gas cycle selected can be open or closed and the absolute pressure levels have not been limited. The evaluation considered 3 basic schemes, all of which use a gas turbine as a driver and partial recovery of engine heat. These include; Brayton-Brayton heat pump with closed cycle refrigerator, Brayton-Brayton heat pump open on low-pressure side, and Brayton-Brayton heat pump open on high pressure side. The calculation procedure and a discussion of the results are presented. (MOW)

30875 **(DOE/ET/12866—5) Residual-Energy-Applications Program environmental analysis report.** (South Carolina Energy Research Inst., Columbia (USA)). Oct 1980. Contract AC09-77ET12866. 48p. NTIS, PC A03/MF A01. Order Number DE81027538.

It is recommended that a generic environmental analysis in support of the Residual Energy Applications Program (REAP) be undertaken. It should be guided by Department of Energy guidelines for compliance with the National Environmental Policy Act. It is further recommended that the Par Pond cooling system at the Savannah River Plant be given strong consideration for siting of the Energy Applied Systems Test (EAST) Facility. The Par Pond system has the potential to confine all potential environmental impacts of the construction and operation of the EAST Facility within the boundaries of the Savannah River Plant. Characteristics of the EAST Facitlity, a place to test industrial scale waste heat recovery equipment, are described and a general description of Par Pond is given. A detailed literatuture review pertaining to fish in PAR Pond and birds near-by is presented.

30876 **(DOE/ET/12866—6) Residual-energy-applications program: support and integration report.** (South Carolina Energy Research Inst., Columbia (USA)). Nov 1980. Contract AC09-77ET12866. 94p. NTIS, PC A05/MF A01. Order Number DE81025479.

The proposed government-owned EAST Facility at the Savannah River Plant in Aiken, South Carolina, would provide capabilities for development and confidence testing of industrial heat pumps, high temperature bottoming cycles, low temperature Rankine cycle power generation systems, and absorption chillers. This work is one component of the Residual Energy Applications Program (REAP). Other documents provide initial considerations concerning the heat pump and power generation systems to be tested at EAST, policy, objectives and guidelines for operation of the facility, a preliminary conceptual design, and environmental data. This report describes support and integration activities that were performed during the contract year. The various elements that impact on the EAST Facility are discussed and an assessment of the EAST Facility mission is given. The report concludes with proposed milestones, schedules, and costs for design, construction, and operation of the facility.

30877 **(DOE/ET/12866—8-Vol.1) Residual-energy-application program: EAST -facility requirements document.** Yngve, P.W.; Zander, F.H. (South Carolina Energy Research Inst., Columbia (USA)). 31 Jul 1981. Contract AC09-77ET12866. 85p. NTIS, PC A05/MF A01. Order Number DE81027536.

An Energy Applied Systems Test (EAST) Facility will be constructed at the Savannah River Plant to serve as the primary

systems test and evaluation facility for the Department of Energy's Residual Energy Applications Program (REAP). The REAP goal is to stimulate the private sector to use available residual heat currently being dissipated. The objectives of the EAST Facility are to perform research and development on heat energy recovery and conversion equipment; establish high confidence in system performance, system availability, and system operating, maintenance, and material costs; and provide a national competence in technologies required for the installation and operation of heat recovery systems. The purpose of this document is to provide design specifications for the EAST Facility. Volume I presents an initial testing capability recommended for EAST and design specifications are provided for the physical plant and major test support systems. Five options are included for tailoring the full-up testing capability to reduce costs of the core facility.

30878 **(DOE/TIC—1028377) Trimming your energy costs in the plywood and veneer industry.** (American Plywood Association, Tacoma, WA; Hardwood Plywood Manufacturers Association, Reston, VA (USA)). 1980. 54p. NTIS, PC A04/MF A01. Order Number DE81028377.

Ideas and techniques for energy conservation that can be implemented now in the plywood industry are presented. Particular emphasis is placed on short payback periods, wide range of applicability, and ease of implementation. Actual energy use data for plants in different parts of the US were analyzed. Energy management questions are addressed and how to change equipment maintenance practices, what technology can save energy, and how to make capital investments are discussed. Measures to reduce the cost of process energy, lighting, and heating costs are covered. Recommendations for using wood wastes efficiently as a source of fuel are made. (MCW)

30879 **(IS-M—321) Power-plant fly-ash utilization: a chemical processing perspective.** Burnet, G.; Murtha, M.J. (Ames Lab., IA (USA)). 1981. Contract W-7405-ENG-82. 12p. (CONF-810151—1). NTIS, PC A02/MF A01. Order Number DE81025452.

From Portland Cement Association conference on manufacturing process; Albuquerque, NM, USA (14 Jan 1981).

The 1976 Resource Conservation and Recovery Act (RCRA) deals with the management of solid and hazardous wastes, and encourages energy and resource recovery. Recent research has indicated that solid wastes from coal combustion, including fly ash, could be classified as hazardous under present EPA definitions. The seriousness of this possibility has been recognized and new rules for coal ash waste disposal are being considered. Ames Laboratory research on fly ash utilization as an alternative to disposal includes extraction of metals from the ash and discovery of uses for the process residues. Recovery of alumina and iron oxides by physical and chemical processing would permit large scale utilization of fly ash and help reduce dependency on imports. One of the processes investigated uses a lime-soda sinter method to form soluble aluminate compounds from mixtures of fly ash, limestone, and soda ash. The aluminates are extracted, treated to remove silicates, and precipitated: the precipitate is calcined to metallurgical grade alumina. The extract residue shows promise as a raw material for the production of Portland cement. Process economics are presented, and the effects of alumina and silica contents of the fly ash, sintering temperatures and time, and sales credits for by-products are discussed.

30880 **(SERI/CP—633-1145, pp 131-137) Review of industrial energy use.** Hamel, B.B.; Brown, H.L. (General Energy Associates, Inc., Philadelphia, PA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

Three principal areas are addressed: the basic approach used to construct General Energy Associates (GEA) industrial data system; some general observations about energy use in the industrial sector at the national level; and some specific examples of the rather specific definition of industrial process heat requirements for a given industry and geographic region, such as petroleum refineries in the Southwest. The work of GEA in developing large industrial data systems is briefly reviewed and results on national and regional use are described.

30881 **Merichem foresees 51.5% energy use reduction by year's end as compared with 1974.** Leach, G.L.; Isaacs, M. (Merichem Co., Houston, TX). *Chemical Processing (Chicago)* ; **44**: No. 9, 21-22(Aug 1981).

Merichem produces phenols, cresylic acids, sodium sulfide and sodium carbonate and is America's biggest processor of spent caustic soda. Energy conservation measures which were adopted by Merichem include insulation, improved efficiency, and heat recovery. They are described briefly. (DLC)

30882 **Electric process heating in industry.** Depew, B.W. (Heat Engineering and Supply Co., El Monte, CA). *Electrical Construction and Maintenance* ; **79**: No. 12, 52-55(Dec 1980).

The unique advantages of electricity for many industrial applications are discussed. The specific advantages of a direct electric-heat system discussed are: elimination of a large inventory of expensive heat transfer fluid; improvement of production output by shortening heating and cooling response to temperature or other process changes; reduction in cost of support structures, drives, etc. due to weight differences; surface temperature itself is controlled instead of the heat transfer fluid; and maintenance is reduced due to the elimination of swivel joints that carry fluid to and from the drum. Electric heaters can be installed usually where needed. Conversion efficiency from electricity to heat energy in resistance-heating applications is illustrated with a discussion on the use of a typical fluidized bed reactor. (MCW)

30883 **Thermodynamic aspects of energy conservation.** Van Gool, W. (State Univ, Utrecht, Neth). *Energy (Oxford)* ; **5**: No. 8-9, 783-792(Aug-Sep 1980). (CONF-790886—).

From Second law of thermodynamics workshop; Washington, DC, USA (14 Aug 1979).

Thermodynamics deals with processes in a time independent approach. Industrial productions and many other activities are bound to perform a certain production per unit of time. It is demonstrated that the stationary process model is a useful tool in relating thermodynamic functions to the velocity of the process. Limitations on the use of functions such as Gibbs free energy and exergy are discussed with respect to the existing energy system. The quality of energy carriers is discussed using statistical mechanics. Energy losses due to an increasing process intensity (the velocity per unit of volume or surface) can be analyzed with either thermodynamics of irreversible processes or engineering data. Changing the conditions of a process, as in approximating the equilibrium situation, will lead to an increase of the size of the equipment when the production volume per unit of time is kept constant. A real energy minimum can be defined when the energy necessary to make equipment is taken into account. This minimum does not coincide with the thermodynamic limit. The importance of the energy embodied in the equipment for the development of conservation policy is explained. A brief discussion of the paper is appended. 18 refs.

30884 **Testing of heat pipes for cooling a 425/degree/c injection mold.** Feldman, K.T. Jr.; Marjon, P.L.; Hahn, D.R. (Univ of NM, Albuquerque). *American Society of Mechanical Engineers, [Paper]* ; No. 80-HT-100, 1-7(Jul 1980).

In order to increase the production rate of a mold used to manufacture foam parts, a mold cooling system was designed to use air cooled finned heat pipes. The cooling system was designed to cool the mold from 425 to 150 C (800 to 300 F) at a rate of 28 C (50 F) per minute. Candidate heat pipes were built and tested using 1.91-cm-OD steel tube with spiral wound, welded, and segmented fins and with Dowtherm A working fluid. 2 refs.

30885 **Energy production from straw. Final report.** Strehler, A. Luxembourg; Commission of the European Communities (1980). 86p. (In German). (EUR—6955-DE). European Community Information Service, Washington, DC.

Tabulated and graphically presented data are given for current (1977) and expected production of wheat, rye, oats, and barley in the German Federal Republic with respect to the various areas of cultivation and regions of the country, particularly Bavaria. Tabulated breakdowns are given for the caloric value of various species

of grain, including their moisture content. Tabulated data are also given for optimal combustion systems with respect to energy consumption with reference to heating requirements for industrial, domestic, and agricultural installations for which the use of processed straw is discussed. Data are presented on the cost of recovering, transporting, and storing straw briquets, cobs, and pellets for fuel purposes.

30886 **Utilization of fluidized bed combustion by-products in fired structured materials.** Slonaker, J.F. (WVa Univ, Morgantown). *West Virginia University Coal Research Bureau Technical Report ;* No. 169, vp(May 1979).

The utilization potential of fluidized bed combustion by-products in fired structural materials is discussed in this report. The by-products investigated were obtained from the Pope, Evans and Robbins process at Rivesville, West Virginia.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 30074, 30093, 30094, 30712, 30760, 30765, 30767, 31080

30887 (CONF-790346—, pp 8p, Paper 13) **Modern coal fired high temperature water (HTW) heat plant.** Peavy, B.; Karabensh, R.S. 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

A heat plant with a high temperature water disribution system to be installed at the Francis E. Warren Air Force Base is described. The plant features three identical vertical coal-fired high temperature water generators utilizing Wyoming coal. Plant capacity and system operation, equipment selections, and environmental considerations are discussed. (MCW)

30888 (CONF-790346—, pp 22p, Paper 14) **United States Air Force model base program: a DOE/DOD Energy Showcase Initiative for McClellan AFB, California.** 1979. NTIS, PC A11/MF A01.

From Conference on conservation: energy management by design; El Paso, TX, USA (8 Mar 1979).

The McClellan AFB DOE/DOD Energy Showcase Initiative program described includes use of a full range of energy conservation technology and alternate energy sources, an estimate of the benefits accrued by DOE and DOD, and the management organization necessary to accomplish the program fully. The program is conceptual in form; however, the concept is fully explained and all known Energy Showcase Initiative requirements are met. A brief description of McClellan AFB is presented. The energy conserving technologies considered cover systems/designs capable of conserving energy derived from existing sources and the alternate energy sources evaluated cover those other than what are currently consumed at McClellan. These include: chemical, nuclear, solar, geothermal, and refuse/biomass. (MCW)

30889 **(DOE/R5/10248—T1) Earth-sheltered industrial utility park. Final report.** (Cumberland Development Corp., WI (USA)). Apr 1981. Contract FG02-80R510248. 78p. NTIS, PC A05/MF A01. Order Number DE81028667.

The potential to develop the Cumberland (Wisconsin) industrial park site using earth-integrated techniques is discussed. The concept feasibility study concerned the site, the land-use plan, and building types. An assessment of energy use in the Cumberland community for 1979 and 1980 was made by compiling sales data from the various suppliers of gasoline, diesel, electricity, natural gas, and other fuels. A resource and technology assessment of biomass feedstocks for a possible community scale bioenergy facility was made. Details of each element of the study are presented and conclusions are summarized. (MCW)

30890 **(TVA/ONR/PCS—81/1) Final environmental impact statement. Alternative electric power rate structures.** (Tennessee Valley Authority, Norris (USA)). 1981. 24p. NTIS, PC A02/MF A01.

TVA is considering adopting and implementing alternative rate structures. The objectives of such an action are to encourage conservation of electricity, increase the efficient use of facilities and resources, and provide for more equitable rates among electric consumers. The alternative rate structures proposed include ratemaking concepts identified by the Public Utility Regulatory Policies Act of 1978. Implementing alternative rate structures would have no direct effect on the physical environment and any socio-economic effects would be insignficant. Any indirect physical impacts would be insignificant in the short term and any long-term effects would be positive. TVA's studies suggest that these positive effects would be significant but that it is impossible to accurately predict with the state of today's knowledge the specific quantified impacts.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 30815

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 30908, 30909, 30909

30891 **(AD-A—090977) Influence of mico fuels on engine performance, exhaust emissions, and performance. Interim report.** Tataiah, K.; Lestz, S.J. (Southwest Research Inst., San Antonio, TX (USA). Army Fuels and Lubricants Research Lab.). Dec 1979. Contracts DAAK70-78-C-0001;DAAK70-80-C-0001. 87p. NTIS, PC A05/MF A01.

The influence of Micronized Coal-in-Oil (MICO) fuels on engine performance and exhaust emissions was experimentally studied in a single-cylinder Hatz diesel engine. One of these fuels, which contained 20 wt% coal, was also examined for its effects on engine endurance and wear in a four-cylinder Mercedes diesel engine. The performance and emissions tests were conducted at twelve different steady-state conditions covering the operating speed-load range of the engine. In each test, the exhaust emissions (including particulates, sulfates, and smoke), crankcase blowby, and temperatures were measured, and brake thermal efficiency and air-fuel ratio was calculated. The results obtained with the single-cylinder engine indicate that the coal in MICO fuel hinders the combustion of the diesel component and decreases the overall brake thermal efficiency of the engine. Although the coal reduces the consumption of diesel fuel component, the total energy consumption is higher.

30892 **(AD-A—091011) Exhaust emissions characteristics and variability for Pratt and Whitney JT8D-7A gas turbine engines subjected to major overhaul and repair. Final report Nov 1978-Feb 1979.** Becker, E.E.; Frings, G.; Cavage, W.C. (Federal Aviation Administration, Atlantic City, NJ (USA). Technical Center). Sep 1980. 55p. NTIS, PC A04/MF A01.

Seven Pratt and Whitney Aircraft (PWA) JT8D-7A turbofan engines were tested at Kennedy International Airport, New York, to evaluate exhaust emissions characteristics and data variability after overhaul. The measured data show that the engines tested did not meet the Environmental Protection Agency (EPA) emission standards. A comparison of the measured data, obtained from the seven overhauled engines evaluated under this program, with new engine data obtained from PWA show that there is a great deal of similarity between the two sets of data. Differences shown in this report between new engine and overhauled engine data are due to the quantity of the engines sampled; the new engine data represent a larger sample size. Satisfactory data can be measured by using the test procedures, instrumentation, and equipment defined in this report.

30893 **(AD-A—091755) Regenerative engine analysis. Final report.** Tameo, R.P.; Vinson, P.W.; Neitzel, R.E. (General Electric Co., Lynn, MA (USA). Aircraft Engine Group). Oct 1980. Contract DAAK51-79-C-0055. 140p. NTIS, PC A07/MF A01.

This report summarizes the results of a regenerative turboshaft study. The work was performed in two tasks. Task I was a 4-

month parametric study of cyclic and recuperator design parameters leading to the selection of those parameters providing minimum fuel consumption and life-cycle cost. Task II consisted of a 2-month preliminary design of a selected regenerative engine cycle.

30894 (AD-A—091777) Reduction of exhaust smoke from gas-turbine engines by using fuel emulsions. Final report. Moses, C.A.; Coon, C.W.; Altavilla, P.A. (Southwest Research Inst., San Antonio, TX (USA). Army Fuels and Lubricants Research Lab.). 21 Oct 1980. Contract N68335-76-C-1136. 92p. NTIS PC MF A01.

Low-internal-phase ratio emulsions of water-in-fuel have been investigated for their potential in reducing exhaust smoke from gas-turbine engines. The unique mechanism is the selective vaporization of the internal phase during the period of droplet heating. Experiments were conducted in a combustor facility fabricated from T-63 engine hardware using a single-can combustor with a dual-orifice pressure atomizer. Two series of tests were performed. The initial sequence employed air flow conditions that simulated full engine power (the smokiest condition). During the experiments, the fuel specifications, water concentration, surfactant concentration, and dispersion size were varied, and measurements of exhaust smoke, combustor temperature rise, flame radiation, and combustion efficiency based upon exhaust chemistry were obtained. The initial series of experiments suggested that a 48 percent reduction in exhaust particulate concentration, based upon a correlation due to Champagne, was possible with an emulsion having a water-to-fuel ratio of 0.1. The later series of tests was oriented toward optimization of the water concentration for smoke reduction and examination of the complete engine power spectrum.

30895 (ANL/CNSV-TM—75) Heavy-duty engines analysis, Study 3: applications of gas-turbine engines for heavy-duty drucks. Jacobson, D.H. (Argonne National Lab., IL (USA)). Jul 1981. Contract W-31-109-ENG-38. 49p. NTIS, PC A03/MF A01. Order Number DE81028494.

This report was prepared as a planning document to establish the operational acceptance, technical feasibility, economic viability, and benefits of introducing gas turbine power systems into commercial trucking operations. This study describes the scope of the total program and identifies the key elements and steps that will be required to conduct an effective demonstration-to-production evaluation program. A description of the turbine engines available for near term installation in representative vehicles, including the development status, projected performance, delivery schedule, and cost estimates are included. The impact of technological advancement in the areas of ceramics, controls, transmissions, and heat exchangers has also been factored into the study to project the full potential that could be realized by the advanced propulsion system. Evaluation and assessment criteria have been reviewed.

30896 (PB—81-121964) The aftermarket costs of heavy-duty diesel mufflers. Technical report. Heiser, D. (Environmental Protection Agency, Ann Arbor, MI (USA)). Jul 1980. 14p. NTIS, PC A02/MF A01.

EPA is preparing to propose a heavy-duty diesel particulate emission standard. One possible control technique is the trap-oxidizer. The addition of a trap-oxidizer will require the use of an exhaust system that will last the lifetime of a vehicle (i.e., a stainless steel system). The trap-oxidizer has also been shown to reduce engine noise as well as current mufflers. Thus, its use should eliminate the need for the muffler. This elimination would reduce maintenance costs, since the muffler would no longer need to be replaced. These savings would need to be taken into account when determining the net cost per vehicle of adding a trap-oxidizer. To estimate these savings, the aftermarket costs of mufflers must be known. Representative aftermarket muffler costs will thus be estimated in this report for the various heavy-duty vehicle classes.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 30667

30897 (AD-A—091412) An experimental study of methanol reformation. Master's thesis. Shafer, J.B. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). Dec 1979. 110p. NTIS, PC A06/MF A01.

Transportation vehicles' overall efficiency could be greatly increased if a hydrogen-air fuel cell served as the power source. Carrying hydrogen on board a vehicle presents immense weight and safety problems, however, and the fuel cell vehicle has so far been successful only in space or research study. Reforming of a source fuel into a hydrogen-rich gas offers a solution to the problems, especially if waste heat from the fuel cell can be used in the reforming. This paper discusses the ideas behind fuel cell vehicles, the choice of methanol as the source fuel and the detailed design and construction of a reformer system to test the possibilities. The reformer system is now operating at The University of Arizona, and early data has provided successful results. The system was designed to be reliable and capable of testing methanol reforming using variables of temperature, pressure, methanol to water ratio, carbon buildup, flow rate and differing catalysts. Early results predict that at temperatures of 400 F and below a larger catalyst volume may be required to produce the volume of hydrogen needed at fuel cell maximum power. Ethanol research is proposed.

30898 (DOE/CS/50121—T1) Operation of the Lectric Leopard. Final report. Kamm, I.O. (Stevens Inst. of Tech., Hoboken, NJ (USA)). Jul 1981. Contract FG01-79CS50121. 93p. NTIS, PC A05/MF A01. Order Number DE81026281.

The vehicle selected for the demonstration project is a Lectric Leopard built by US Electricar Corporation. The vehicle was unable to fulfill the intentions of the program because of continuous failures in the control system and an inability of the factory to fix them. Our requests to obtain circuit diagrams of the system so that we could make repairs ourselves were turned down, stating that this information was proprietary. The vehicle was demonstrated three times, to a student audience, Public Service Electric and Gas Company Day at Stevens and the Rotary Club of Hoboken; but because of the large amounts of downtime the vehicle only accumulated 900 miles over a one year period. In May 1981 we were informed that in a frontal barrier test, the rear batteries had broken loose delivering a second impact on the driver and dumping several gallons of acid into the occupant compartment. On the advise of DOE the vehicle has not been used since. If Stevens is permitted to keep the vehicle it is our intent to make it the subject of several student senior design projects to make the vehicle safe for use by containerizing the rear batteries.

30899 (DOE/CS/51294—T6) Preliminary design review report. Phase I. Deliverable Item 5. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 1 Oct 1976. Contract AC03-76CS51294. 56p. NTIS, PC A04/MF A01. Order Number DE81027063.

The electric vehicle preliminary design was reviewed and the electric vehicle drive system trade-off studies were completed. Design aspects considered included: drive system trade-offs; battery operational characteristics; structural design; power circuits; battery charger; vehicle gradeability; cold soak; cost; baseline vehicle specifications; and upgrading to approach ERDA goals. There were no deficiencies noted with respect to the contract requirements. However, not all of the ERDA performance goals will be met. Those ERDA goals which will not be met are minimum urban range of 75 miles on the SAE J227A Schedule D driving cycle; sustained speed of 50 mph on a 5% grade; operation after an unserviced park at -20°F for 7 days, battery recharging from a 120 volt, single-phase outlet in 6 h. No design changes in the Baseline Vehicle were recommended. Potential areas for upgrading were noted such as the use of an improved battery, introduction of a shifting transmission, and use of a flywheel to supply energy for acceleration. Specific upgrading approaches will be recommended and included in the Development Plan.

30900 (DOE/CS/51294—T7) Conceptual design review report. Phase I: deliverable item 4. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 4 Oct 1976. Contract AC03-76CS51294. 5p. NTIS, PC A02/MF A01. Order Number DE81027055.

This design review report for an electric-powered vehicle program consists of a list of design aspects considered. (LCL)

30901 **(SERI/RR—742-1068) Rapid charging of lead-acid batteries for electric-vehicle propulsion and solar-electric storage.** Longrigg, P. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1981. Contract AC02-77CH00178. 44p. NTIS, PC A03/MF A01. Order Number DE81028084.

A survey of the various charging techniques that are available and that have been used extensively for lead-acid batteries is presented. Also, descriptions of newer techniques involving gas evolution-controlled charging are included. An evaluation of fast charge approaches, with an analysis of battery state equations, is presented. (WHK)

30902 **Aluminum air unit cell for electric vehicles successfully tested.** *Light Metal Age ;* **38**: No. 11-12, 30(Dec 1980).

A power cell which uses aluminum, air and tap water as fuels has been tested at Lawrence Livermore National Laboratory in California.

3305 Flywheel Propulsion

30903 **Matched metal die compression molded structural random fiber sheet molding compound flywheel.** Kulkarni, S.V.; Christensen, R.M.; Toland, R.H. (to Dept. of Energy). US Patent Application 190,305. 24 Sep 1980. 12p.

A flywheel is described that is useful for energy storage in a hybrid vehicle automotive power system or in some stationary applications. The flywheel has a body of essentially planar isotropic high strength structural random fiber sheet molding compound (SMC-R). The flywheel may be economically produced by a matched metal die compression molding process. The flywheel makes energy intensive efficient use of a fiber/resin composite while having a shape designed by theory assuming planar isotropy.

30904 **Rimmed and edge thickened stodola shaped flywheel.** Kulkarni, S.V.; Stone, R.G. (to Dept. of Energy). US Patent Application 190,306. 24 Sep 1980. 17p.

A flywheel is described that is useful for energy storage in a hybrid vehicle automotive power system or in some stationary applications. The flywheel has a body composed of essentially planar isotropic high strength material. The flywheel body is enclosed by a rim of circumferentially wound fiber embedded in resin. The rim promotes flywheel safety and survivability. The flywheel has a truncated and edge thickened Stodola shape designed to optimize system mass and energy storage capability.

3306 Vehicle Design Factors

30905 **(DOE/CS/51095—T2) Study of reduction of accessory horsepower requirements. Seventh quarterly progress report.** (AiResearch Mfg. Co., Phoenix, AZ (USA)). 30 May 1976. Contract AC03-76CS51095. 63p. NTIS, PC A04/MF A01. Order Number DE81016853.

Progress is reported for a program whose objective is to evolve and define an accessory drive system that will minimize system power consumption of driven accessories on an internal combustion engine in a passenger automobile. Although the primary goal is fuel economy improvements, the manner of accomplishment must be acceptable to both manufacturer and customer. Factors such as first cost, maintainability, and impact on existing capital investment were significant considerations in selecting a variable ratio belt drive as the speed control mechanism. Tasks completed in this quarter were: the design, fabrication, component, and laboratory engine tests of prototype variable ratio belt drive; and baseline compact car computer modeling and computer drive cycle analyses utilizing the accessory drive system. The major accomplishments in this quarter were: mechanical and hydromechanical accessory drive systems were installed in the vehicle and tested; initial drive system performance evaluation was completed; emissions and fuel economy testing was completed in accordance with the federal test procedure; fuel economy simulator was completed and is functional; initial road test of mechanical accessory drive system was completed and reflects valid fuel economy improvements; and mechanical accessory drive system off-design analysis was completed.

30906 **(DOE/CS/51097—T1) Design and development of a continuously variable ratio transmission for an automotive vehicle. 3rd quarterly progress report.** (Orshansky Transmission Corp., San Diego, CA (USA)). 31 Oct 1975. Contract AC03-76CS51097. 54p. NTIS, PC A04/MF A01. Order Number DE81027476.

The purpose of this program is to design, build and test a hydromechanical transmission which has a continuously variable speed ratio that is independent of torque level and which operates at the highest possible efficiency. The program is divided into two phases. Phase I consists primarily of the design of the transmission. Also included in Phase I are: (1) the design of hydraulic module test equipment, (2) procurement of hydraulic module components and test equipment, (3) the design and construction of an electronic simulator, (4) the assembly of the hydraulic module, and (5) computer performance analysis, including AAPSD alternate engines. Phase II consists primarily of procurement, fabrication and testing of two prototype transmissions. Also included in Phase II are: (1) a stability analysis utilizing the electronic simulator, and (2) transmission cost estimating. The status of the Phase II testing, to date is described. Included in the test results are hydraulic module efficiency tests, noise measurements, and controls component tests.

30907 **(DOE/CS/51097—T2) Design and development of a continuously-variable-ratio transmission for an automotive vehicle. 4th quarterly progress report.** (Orshansky Transmission Corp., San Diego, CA (USA)). 1975. Contract AC03-76CS51097. 42p. NTIS, PC A03/MF A01. Order Number DE81026734.

The primary effort during the past quarter was placed upon completing procurement of transmission hardware and upon the assembly of the first prototype transmission. Assembly of the first prototype transmission has been completed and testing will start in early January. Efficiency testing and subsequent improvements of the hydrostatic module has continued. This effort has demonstrated very close correlation with the computer-predicted efficiencies from which transmission performance and fuel savings calculations were made. Noise data has been reduced. Results indicate that increases in vehicle noise as a result of noise from the hydromechanical transmission will be less than one (1) dB(A) and therefore will not be discernable to the human ear. Both static and dynamic testing of the swashplate hydraulic control assembly has been performed. Response time of the original proportional valve proved to be insufficient. A larger capacity (no increase in size or mounting configuration) proportional valve was tested and response was improved by a factor of approximately four.

3307 Emission Control

REFER ALSO TO CITATION(S) 30892, 30894, 30896

30908 **(PB—81-119398) Exhaust emissions from a Ford Pinto equipped with the General Dynamics electrosonic control system. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA)). Oct 1976. 18p. NTIS, PC A02/MF A01.

The EPA receives information about many systems which appear to offer potential for emission reduction or fuel economy improvement compared to conventional engines and vehicles. One such system has been developed jointly by General Dynamics and Autotronic Controls Corporation. This system is called the Electronic engine Control System (Electrosonic), and utilizes the principles of lean-burn combustion to control exhaust emissions. The Electrosonic system is designed to control engine parameters affecting exhaust emissions. As such, the system controls ignition timing, air-fuel ratio and idle speed. The system does have EGR control capability, although EGR was not on the 1976 Ford Pinto MPG supplied to the EPA for evaluation.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 30891

30909 (DOE/CE/50021—2) Influence of fuel variables on the operation of automotive open and pre-chamber diesel and spark ignited stratified charge engines: a literature study covering petroleum and syncrude derived fuels, executive summary. Needham, J.R. (Ricardo and Co. Engineers (1927) Ltd., Shoreham-by-Sea (UK)). Sep 1980. Contract AC01-80CS50021. 30p. NTIS, PC A03/MF A01. Order Number DE81028113.

A literature study was carried out to ascertain the influence of fuels and fuel variables on the operation of automotive diesel and spark ignited stratified charge engines with a view to understanding the impact of future fuels derived from syncrude. The findings from the search were presented and discussed in detail in the main report (Ricardo DP.81/539). In this executive summary, the conclusions and recommendations from the main report are presented.

36 MATERIALS

30910 (SAND—81-1139C) Application of the theory of linear elastic materials with voids. Cowin, S.C.; Nunziato, J.W.; Puri, P. (Sandia National Labs., Albuquerque, NM (USA); New Orleans Univ., LA (USA). Dept. of Mathematics; Tulane Univ., New Orleans, LA (USA). Dept. of Biomedical Engineering). 1981. Contract AC04-76DP00789. 12p. (CONF-8106133—1). NTIS, PC A02/MF A01. Order Number DE81027903.

From 4. international conference on continuum models of discrete systems; Stockholm, Sweden (29 Jun 1981).

The linear theory of elastic materials with voids is summarized and some applications are sketched. The theory differs from classical linear elasticity in that the volume fraction corresponding to the void volume is taken as an independent kinematic variable. The following applications of the theory are described briefly: response to homogeneous deformations, inflation of a cylinder and sphere due to internal pressure, pure bending of a beam, and small amplitude acoustic waves. In each of these applications, the change in the void volume induced by the deformation is determined.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 30475, 30476, 30555, 30566, 30571, 30572, 30573, 30575, 30576, 30577, 30578, 30579, 30580, 30581, 30582, 30583, 30584, 30585, 30601, 30622, 30624, 30625, 30635, 30775, 30775, 30775, 31430, 31433, 31482

30911 (BNL—29671) Fracture mechanisms of sensitized stainless steels in sulfur-containing environments. Newman, R.C.; Sieradzki, K.; Isaacs, H.S. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 10p. (CONF-810913—5). NTIS, PC A02/MF A01. Order Number DE81026052.

From International conference on environmental degradation of engineering materials; Blacksburg, VA, USA (21 Sep 1981).

The stress-corrosion cracking of sensitized type 304 stainless steel has been studied in a 6 x 10^{-4}M sodium thiosulfate solution at room temperature. Under constant extension rate conditions the crack initiation probability is a maximum at -100 mV (SCE) and approaches zero for a smooth surface at $<$ -300 or $>$ +300 mV. Initiated cracks propagate at high rates at potentials as high as +500 mV; a maximum crack velocity of $\sim$ 8 $\mu m\ s^{-1}$ has been measured in a precracked specimen under constant load. Crack initiation probability can be correlated with the repassivation behavior of simulated grain boundary material, but the high crack propagation rates probably require a large contribution from intermittent mechanical grain boundary failure.

30912 (CONF-810809—14) Phonon-limited lifetimes of electrons in Pd. Khan, F.S.; Allen, P.B.; Butler, W.H. (Oak Ridge National Lab., TN (USA); State Univ. of New York, Stony Brook (USA). Dept. of Physics). 1981. Contract W-7405-ENG-26. 2p. NTIS, PC A02/MF A01. Order Number DE81028608.

From 16. international conference on low temperature physics; Los Angeles, CA, USA (19 Aug 1981).

Quasiparticle lifetimes 1/tau/sub k/ are calculated for electrons on the Fermi surface (FS) of Pd using the rigid muffin tin model. Results are presented for the gamma-centered and the open sheets.

30913 (CONF-810828—5) Effects of pressure on the mixed valent properties of Ce and its intermetallic compounds. Liu, S.H. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01. Order Number DE81028572.

From Conference on high pressure physics; Bad Honnef, F.R. Germany (Aug 1981).

The rare earth element Ce and a number of rare earth compounds exhibit valence transition under pressure. This has been one of the most active research topics in recent years. There also exist several intermetallic compounds of Ce that do not unergo abrupt valence changes. Instead, the valence varies continuously with pressure or temperature. A systematic high pressure study of these compounds will further elucidate the phenomenon of valence fluctuation. For these materials, the single parameter which is most sensitive to the pressure is the position of the Ce 4f level relative to the conduction bands. Therefore, it should be possible to monitor the valence with pressure and follow the evolvement of the system from a local moment state to a nonmagnetic state. The latter may be a spin compensated Kondo lattice state of a lattice of virtual bound states. The experimental evidence of these exotic states is reviewed, and new experiments to investigate their physical properties are suggested.

30914 (CONF-810831—9) Resistance of (Fe, $Ni)_3V$ long-range-ordered alloys to neutron and ion irradiation. Braski, D.N. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE81028577.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

A series of (Fe, $Ni)_3V$ long-range-ordered alloys were irradiated with neutrons in the Oak Ridge Research Reactor (ORR) and with 4 MeV Ni ions at temperatures above 250°C. The displacement damage levels for the two irradiations were 3.8 and 70 dpa, and the helium levels were 29 and 560 at. ppM, respectively. Irradiation in ORR generally increased the yield strength and lowered the ductility of an LRO alloy, but produced relatively little swelling. The LRO alloys retained their long-range order after ion irradiation below the critical ordering temperature, T/sub c/, and exhibited low swelling. Above T/sub c/ the alloys were disordered and showed greater swelling. Adjustment of alloy composition to prevent sigma phase formation reduced swelling.

30915 (CONF-810831—10) Effect of low-temperature irradiation with (n,α) helium production on tensile properties of 12 Cr-1 Mo VW-type steels. Klueh, R.L.; Vitek, J.M.; Grossbeck, M.L. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE81028578.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Tensile specimens from small heats of ferritic (martensitic) steel based on 12 Cr-1 Mo VW have been irradiated in the High Flux Isotope Reator (HFIR) at $\sim$ 50°C to displacement damage levels of up to 9.5 dpa. Two heats of 12 Cr-1 Mo VW steel were irradiated, along with similar alloys to which nickel had been added. Transmutation of the ^{58}Ni by thermal neutrons during irradiation in HFIR leads to helium production rates similar to those anticipated in a fusion reactor. Displacement damage is produced simultaneously by the fast neutron flux in the reactor. After irradiation, the specimens were tested at room temperature and 300°C. Yield strength and ultimate tensile strength of irradiated samples displayed considerable hardening over the unirradiated condition.

The increased strength was accompanied by a decrease in ductility. Indications are that the hardening resulted only from the displacement damage and was not affected by the transmutation helium formed during irradiation.

30916 **(CONF-810831—13) TEM observations of crack tip: cavity interactions.** Horton, J.A.; Ohr, S.M.; Jesser, W.A. (Oak Ridge National Lab., TN (USA); Virginia Univ., Charlottesville (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE81028574.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Crack tip-cavity interactions have been studied by performing room temperature deformation experiments in a transmission electron microscope on ion-irradiated type 316 stainless steel with small helium containing cavities. Slip dislocations emitted from a crack tip cut, sheared, and thereby elongated cavities without a volume enlargement. As the crack tip approached, a cavity volume enlargement occurred. Instead of the cavities continuing to enlarge until they touch, the walls between the cavities fractured. Fracture surface dimples do not correlate in size or density with these enlarged cavities.

30917 **(CONF-810831—14) Development of iron-base long-range ordered (LRO) alloys for fusion reactor first wall and blanket applications.** Liu, C.T. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE81028613.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Iron-base LRO alloys with base compositions $(Fe,Ni)_3V$ are being developed for fusion reactor applications. The base alloys are modified with <1% Ti for further improvement in metallurgical and mechanical properties. The phase relationships in the LRO alloys depend strongly on the nickel concentration in the range of 31 to 40%. The σ phase field existing in the low nickel alloys at temperatures above their critical ordering temperature (T/sub c/), can be eliminated by increasing nickel content to 40%. Tensile tests as a function of temperature indicate that the LRO alloys have superior high-temperature strength. Unlike conventional alloys, the yield strength of the LRO alloys increases with temperature and reaches a maximum around T/sub c/. As a result, the LRO alloys are much stronger than commercial alloys such as type 316 stainless steel. Titanium additions improve the ductility of the LRO alloys at elevated temperatures. The alloys show excellent creep resistance and structural stability. Long term aging at 550°C does not cause any significant change in tensile properties. The alloys exhibit a sharp decrease in creep rate at T/sub c/. The formation of long-range order lowers the creep rate by more than two orders of magnitude.

30918 **(DOE/ER/04356—4) Electrochemical investigations of novel electrode materials. Progress report, November 1, 1980-October 31, 1981.** Worrell, W.L. (Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science and Engineering). Jun 1981. Contract AS02-77ER04356. 9p. NTIS, PC A02/MF A01. Order Number DE81027460.

This research program is designed to determine the structural and electrochemical properties of the unexplored lithium co-intercalated TiS_2 compounds. Progress during the past year is discussed in three sections: preparation of lithium co-intercalated TiS_2 compounds, structural characterization and electrochemical-cell investigations.

30919 **(DOE/ER/04799—1) Basic study of electroslag welding. Progress report, January 1, 1979-December 31, 1979.** Eagar, T.W.; Szekely, J. (Massachusetts Inst. of Tech., Cambridge (USA)). 1979. Contract AS02-78ER04799. 12p. NTIS, PC A02/MF A01. Order Number DE81027852.

During the initial contract period, a three dimensional model of the heat generation patterns and temperature profiles in the slag and liquid metal phases of the ESW process was formulated. During the present period this model has been refined and extended to include a three-dimensional transient model of melting, solidification and heat transport in the base plates. The experimental work has complemented the theoretical work both by providing input data to the model and by verifying the model predictions. During the current year the welding apparatus has been made fully operational and a series of experiments was carried out welding two inch thick plates. The principal finding of the experimental work was that the size of the heat affected zone is markedly affected by both the gap width and the welding voltage.

30920 **(DOE/ER/05002—T4) Diffusion-induced grain-boundary migration in Au/Cu and Au/Ag thin films.** Pan, J.D.; Balluffi, R.W. (Xerox Palo Alto Research Center, CA (USA); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Jun 1981. Contract AS02-78ER05002. 39p. (COO—5002-21). NTIS, PC A03/MF A01. Order Number DE81027225.

Portions of document are illegible.

Diffusion induced grain boundary migration (DIGM) was studied by transmission electron microscopy and scanning transmission electron microscopy in the gold-rich layer of thin film Au/Cu and Au/Ag diffusion couples posessing grain boundary structures of controlled geometry. When either copper or silver was diffused along the boundaries in the gold-rich layer at temperatures where lattice diffusion was essentially frozen out, the boundaries were induced to migrate leaving alloyed zones behind in their wakes. The structures and compositions of the alloyed zones and the kinetics of the migration under various conditions were studied in detail in a large number of [111] and [001] tilt boundaries in Au/Cu couples and [111] tilt boundaries in Au/Ag couples. The phenomenon was also studied more indirectly by Auger sputter depth profiling ar random boudaries in Au/Ag couples.

30921 **(DOE/ER/10474—3) Improvement of reliability of welding by in-process sensing and control (development of smart welding machines for girth welding of pipes). Third progress report.** Converti, J.; Dror, Y.; Hardt, D.; Liang, S.; Masubuchi, K.; Moore, J.; Paynter, H.; Unkel, W.; Zacksenhouse, M. (Massachusetts Inst. of Tech., Cambridge (USA). School of Engineering). Jun 1981. Contract AS02-79ER10474. 89p. NTIS, PC A05/MF A01. Order Number DE81027464.

This two part progress report covers work from March 16, 1980 to March 15, 1981. The overall objective of this program is to improve the reliability of welding by developing smart welding machines. In addition to exercising strict control of the welding machinery, the smart welding machine exercises real-time, closed-loop control of the weld itself. The weld quality, for the work to date, has been defined in terms of acceptable (full) penetration and weld bead width. Metallurgical defects, gas inclusions and oxidation/wetting problems have not been considered explicitly. Although the concepts and techniques developed have general application to the welding field, the program is focused specifically toward the welding of pipes. Further, the present work condentrates on the root pass(es) using GTAW rather than on the filling process using GMAW.

30922 **(DOE/ER/10475—2) Study and modeling of high-temperature-fatigue crack propagation in austenitic stainless steel. Progress report for 1981.** Davidson, D.L. (Southwest Research Inst., San Antonio, TX (USA)). 1 Aug 1981. Contract AS05-79ER10475. 32p. NTIS, PC A03/MF A01. Order Number DE81028941.

The objective of the work described in this annual report has been to gather information on crack tip plasticity in stainless steels as a function of the variables: stress intensity factor, temperature, environment, frequency, and under creep and fatigue conditions. This report describes interim results of crack tip plasticity determinations in 304 stainless steel with some of the variables.

30923 **(DOE/ET/34215—24) Research on mechanisms of stress corrosion cracking in Zircaloy.** Knorr, D.B.; Pelloux, R.M. (Battelle Pacific Northwest Labs., Richland, WA (USA); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Jun 1981. Contract AC06-76RL01830. 78p. (PNL—3860). NTIS, PC A05/MF A01. Order Number DE81028280.

The results of internal gas pressurization tests, primarily at 320°C, on cladding tubes from two suppliers, Supplier A and Sup-

plier B, are presented. The two lots show a substantial difference in iodine SCC susceptibility so a test matrix is used to resolve the relative contributions of surface condition, residual stress, and texture. Additional tests with constant deflection split-ring specimens and with unstressed cladding segments are used to understand crack initiation and the early crack growth stages of SCC. The difference in SCC susceptibility is due to crystallographic texture. Other variables such as surface finish, stress relief temperature, and residual stress have little or no effect. Mechanical properties, crack initiation, and crack propagation all depend on texture. Both initiation and propagation features are analyzed by scanning electron microscopy. A mechanism for crack initiation consistent with most observations in this study and with the work of other investigators is proposed. At 320°C, lifetime is crack initiation limited while several tests at 390°C indicate that lifetime is less initiation limited at higher temperature. 31 figures, 9 tables.

30924 **(DOE/SF/91001—T5) Sodium technology: 1-FFTF support work, friction tests.** Oliva, R.M.; Horton, P. (Rockwell International Corp., Canoga Park, CA (USA)). 1974. Contract AT03-76SF91001. 76p. NTIS, PC A05/MF A01. Order Number DE81026159.

The objective of this program is to conduct friction screening tests in an environment of high-temperature, high-purity liquid sodium or sodium vapor to: (1) develop backup materials, processes, and vendors for core component wear pads, (2) investigate material treatments and coatings for improvement of wear behavior of common LMFBR structural materials, (3) evaluate weld-deposited hardfacings and/or prefabricated bearing materials for use in long-term, high-temperature, high-fluence regions, (4) evaluate bearing materials with a low potential for change in surface composition due to corrosion or mass transfer effects, and (5) develop statistical confidence in friction values for selected material combinations.

30925 **(EGG-M—03582) SEM examinations of oxidation characteristics of Alloy 800H.** Miley, D.V.; Smolik, G.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 18 Jun 1981. Contract AC07-76ID01570. 38p. NTIS, PC A03/MF A01. Order Number DE81029057.

Oxidation characteristics of Alloy 800H at 1143 and 1253°K observed with SEM techniques are summarized. Different oxide phases developed heterogeneously in an outer layer under which a more continuous, dense, Cr-rich oxide layer formed. Growth rates of these oxides were greatest at grain boundaries, and exfoliation sometimes resulted. Chemical constituents of the various oxide phases were identified by EDS. The current work is being performed to provide a background for subsequent studies of corrosion in sulfur-bearing gases relative to coal gasification environments. 8 figures.

30926 **New evidence on the magnetic structure of Nd.** Moon, R.M.; Koehler, W.C. (Oak Ridge National Lab., TN (USA). Solid State Div.). *Journal of Magnetism and Magnetic Materials ;* **15**: No. 18, 503-504(Jan-Mar 1980).

From International conference on magnetism '79 (ICM); Muenchen, Germany, F.R. (3 - 7 Sep 1979).

Previously reported data on the magnetic structure of Nd above 7.5 K seem to be in conflict with the Landau theory of phase transitions. Evidence for a new magnetic phase transition at 18.6 K is presented. The Landau theory should be applied to the new phase wich exists between 18.6 and 19.9 K.

30927 **Quadrupolar interactions and the magnetic states of HoSb.** Brun, T.O.; Korty, F.W.; Kouvel, J.S. (Argonne National Lab., IL (USA); Illinois Univ., Chicago (USA)). *Journal of Magnetism and Magnetic Materials ;* **15**: No. 18, 298-300(Jan-Mar 1980).

From International conference on magnetism '79 (ICM); Muenchen, Germany, F.R. (3 - 7 Sep 1979).

The magnetic phase diagrams of a HoSb crystal, for fields along various axes, are found to contain antiferromagnetic and ferrimagnetic regimes similar to those of DySb and thus offer analogous evidence for strong quadrupolar interactions. Such interactions are also revealed by analysis of magnetization-field isotherms above the Neel point.

30928 **Amorphous $Nb_{40}Ni_{60}$ produced by Ni^+ ion implantation.** Rechtin, M.D. (Argonne National Lab., IL); Vander Sande, J.; Baldo, P.M. pp 388-389 of Ninth international congress on electron microscopy. Vol. I. Sturgess, J.M. (ed.). Toronto, CA; Microscopial Society of Canada (1978).

From 9. international congress on electron microscopy; Toronto, Ontario, Canada (1 Aug 1978).

Partially crystallized $Nb_{40}Ni_{60}$ ws irradiated to doses of 6 to 20 displacements per atom (dpa) at room temperature and 900°K. Damage distribution was examined. (FS)

30929 **(LA—8877-T) Molecular dynamics calculations for sodium using pseudopotential theory.** Swanson, R.E. (Los Alamos National Lab., NM (USA)). Jun 1981. Contract W-7405-ENG-36. 185p. NTIS, PC A09/MF A01. Order Number DE81029022.

Thesis.

The equation of state of sodium is studied using the molecular dynamics technique whereby the classical motion of a system of ions is solved with the aid of computers. The interaction potential between pairs of sodium ions consists of Coulomb and Born-Mayer repulsion terms and an effective ion-ion interaction derived from pseudopotential theory. This theory includes the effects of electron gas screening, exchange, and correlation. A model pseudopotential with parameters fit to experimental low-temperature data is used. By using this technique, an atomic description of a simple metal proceeds to the calculation of macroscopic thermodynamic properties.

30930 **(LA-UR—81-2082) New ways of looking for phase transitions at multi-megabar dynamic pressures.** Shaner, J.W. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 11p. (CONF-810828—4). NTIS, PC A02/MF A01. Order Number DE81028771.

From Conference on high pressure physics; Bad Honnef, F.R. Germany (Aug 1981).

Shock wave techniques have provided much of our information about very high pressure phase transitions. However, because of the specific thermodynamic region accessible to simple shock wave experiments, phase transitions with very small density changes are difficult to detect. Those phase changes with a density decrease at constant pressure, such as normal melting, are virtually impossible to detect in a shock experiment. Three new techniques have been applied to thermodynamic measurements behind a shock wave, with the result that several previously undetected phase boundaries have been measured. First, optical pyrometry has been used to measure the temperature of shocked SiO_2. A temperature anomaly was found, indicating a phase change, probably melting, between 0.6 and 1.1 Mbar. Secondly, magnetic probes have been used to measure the velocity of sound in shock compressed metals. The loss of a longitudinal elastic component of the sound wave is indicative of melting. Finally, a novel optical analyzer technique, exploiting the sensitivity of thermal radiation to small temperature changes, has also been used to measure the sound velocity in shock compressed metals. With the extra sensitivity provided by this derivative measurement of an equation of state surface, both solid-solid and melting transitions of iron above 2 Mbar have been detected.

30931 **(LA-UR—81-2124) Theoretical equations of state for metals.** Kerley, G.I. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810684—42). NTIS, PC A02/MF A01. Order Number DE81028743.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

Equation of state (EOS) calculations for xenon, iron, and beryllium are described and shown to give good agreement with shock wave experiments. The theory includes models for both solid and fluid phases, calculation of the melting curve, and effects of atomic shell structure on thermal electronic contributions to the EOS.

30932 (LA-UR—81-2257) Impedance-match experiments using high intensity lasers. Holmes, N.C.; Trainor, R.J.; Anderson, R.A.; Veeser, L.R.; Reeves, G.A. (Los Alamos Scientific Lab., NM (USA)). 1981. 4p. (CONF-810684—43). NTIS, PC A02/MF A01. Order Number DE81025802.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

The results of a series of impedance-match experiments using copper-aluminum targets irradiated using the Janus Laser Facility are discussed. The results are compared to extrapolations of data obtained at lower pressures using impact techniques. The sources of errors are described and evaluated. The potential of lasers for high accuracy equation of state investigations are discussed.

30933 (LA-UR—81-2266) Response of metallic glasses $Fe_{40}Ni_{40}P_{14}B_6$ and $Fe_{80}B_{20}$ to irradiation with 800-MeV protons. Cost, J.R.; Sommer, W.F. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810831—17). NTIS, PC A02/MF A01. Order Number DE81028705.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Metallic glasses with compositions of $Fe_{40}Ni_{40}P_{14}B_6$ and $Fe_{80}B_{20}$ were irradiated in the 800 MeV proton beam at the Los Alamos Meson Physics Facility while the electrical resistance and length changes were monitored. The resistance and the length of the first alloy were both found to increase and saturate with dose to $\Delta R/R \cong 5 \times 10^{-3}$ and $\Delta L/L \cong 2 \times 10^{-3}$. For the second alloy the total dose of 1.1×10^{19} p/cm^2, which was calculated to give roughly 0.12 dpa, was slightly less than that required for saturation. No annealing of these increases was observed for anneals from room temperature to 250°C. These results are interpreted in terms of a model in which collision cascades create small regions of increased atomic disorder which fully overlap each other at saturation.

30934 (LA-UR—81-2367) Impedance-matching experiments using high-pressure, laser-driven shock waves. Veeser, L.R.; Reeves, G.A.; Holmes, N.C.; Trainor, R.J.; Anderson, R.A. (Los Alamos National Lab., NM (USA); California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1981. Contract W-7405-ENG-36. 5p. (CONF-810827—4). NTIS, PC A02/MF A01. Order Number DE81028732.

From 8. AIRAPT conference and 19. EHPRG conference; Uppsala, Sweden (17 Aug 1981).

A high-power laser was used to produce shock waves with pressures of 300 to 700 GPa. A series of impedance-matching experiments on aluminum-copper systems with 10% accuracy indicate several areas in which the experiment can be improved to reduce the errors. Several such improvements are now being made, including upgrading both the laser and recording systems and modifying the target characterization techniques.

30935 (LBL—12879) Study of electropolishing of ferrous alloys using rotating-disk electrodes. Hryniewich, T.; Muller, R.H.; Tobias, C.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1981. Contract W-7405-ENG-48. 127p. NTIS, PC A07/MF A01. Order Number DE81028898.

This work deals with electropolishing of ferrous materials ranging from pure iron through carbon steels, with increasing carbon content, to a few low-alloy steels. The characteristics of electropolishing stainless and acid-proof steels are well known, and for this reason were not considered in this research. Studies were performed on the rotating disk electrode system under controlled electrochemical and hydrodynamic conditions. The purpose was to establish conditions at which the best surface finish, after electropolishing of different types of ferrous alloys, may be achieved. The work involved investigations over a wide range of applied current density, mass loss, and current efficiency.

30936 (LBL—12903) Role of the microstructural components in a three-step heat cycled, low carbon Fe-6Ni alloy. Kim, H.J. (Lawrence Berkeley Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 64p. NTIS, PC A04/MF A01. Order Number DE81027396.

Thesis.

The role of each microstructural component (i.e., ultrafine-grain, stable retained austenite, and tempered martensite matrix) in a three-step heat cycled, low carbon Fe-6Ni cryogenic alloy, which had shown excellent cryogenic properties, were studied independently through investigations of the mechanical properties and transformational behaviors of two simulated alloys. As a result, it was found that each component contributed to overall properties of the cryogenic alloy uniquely as follows: the ductile-brittle transition temperature is suppressed effectively by grain refinement; stable retained austenite in ferritic steel increases the cryogenic toughness by grain refinement; and the martensite matrix of ferritic steel affects the Charpy upper shelf energy alone. It also was found that an excellent cryogenic toughness was obtainable by the combined effects of each microstructural component of the alloy.

30937 (LBL—12955) Electrochemical properties of small clusters of metal atoms and their role in the surface-enhanced Raman scattering. Plieth, W.J. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01. Order Number DE81024198.

Starting with equations for the shift of the reversible redox potential of small metal particles with size, the electrochemical properties of these particles are discussed. Approximate equations are given for the relationship between the particle size and the surface charge, the potential of zero charge, the surface potential, work function and quantities related to this function. The influence of these properties on redox reactions, electrosorption and chemisorption are discussed. The results are used to explain experimental observation in connection with the surface enhanced Raman effect.

30938 (MLM—2848(OP)) Microstructural analysis of Kovar/molybdenum and copper/molybdenum interdiffusion. Kelly, M.D.; Breakall, K.L. Jr.; Roesch, D.L. (Mound Facility, Miamisburg, OH (USA)). 1981. Contract AC04-76DP00053. 13p. (CONF-810731—1). NTIS, PC A02/MF A01. Order Number DE81025919.

From 14. annual technology meeting of international metallographic society; San Francisco, CA, USA (21 Jul 1981).

Studies were conducted to measure interdiffusion of Kovar/molybdenum and copper/molybdenum at different temperatures for various periods of times. The study was conducted to determine optimum operating parameters to achieve good bonding, while maintaining practical processng time. Metallographic techniques were developed to prepare specimens for microprobe analysis, and to etch specimens for photomicrography. The metallographic techniques used, along with the resulting microprobe analyses, are discussed. 7 figures.

30939 (ORNL—5783) Thermal aging behavior of ERNiCr-3 alloy (weld and base metal). Klueh, R.L.; King, J.F. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 36p. NTIS, PC A03/MF A01. Order Number DE81027047.

The nickel-base filler metal alloy ERNiCr-3, containing nominally 67% Ni, 20% Cr, 3% Fe, 3% Mn, and 2.5% Nb, is used widely to make welds for elevated-temperature service. To determine the effect of elevated temperature on tensile and creep-rupture properties of ERNiCr-3, weld metal specimens were thermally aged to 10,000 h at 510°C, to 15,000 h at 566°C, and to 1000 h at 677°C. Wrought ERNiCr-3 was also aged at 566 and 677°C. The 0.2% yield strength of the ERNiCr-3 weld metal increased with thermal aging time at 510 and 566°C. The ultimate tensile strength also increased continuously with aging time at 566°C, whereas at 510°C, it went through a maximum (the strength of the material aged 10,000 h was less than was that aged 5000 h).

30940 Low-temperature phase transition in alpha-uranium. An old problem revisited. Lander, G.H. (Argonne National Lab., Evanston, IL (USA)); Smith, H.G.; Wakabayashi, N. (Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials ;* **95**: No. 3, 307-310(Dec 1980).

30941 (PB—81-126351) Regional air pollution study: effects of airborne sulfur pollutants on materials. Final report. Mansfeld, F. (Rockwell International Corp., Creve Coeur, MO (USA). Environmental Monitoring and Services Center). Jan 1980. Contract EPA-68-02-2093. 180p. NTIS, PC A09/MF A01.

Samples of galvanized steel, weathering steel, A1 2014 and 7079 stress samples, silver, marble, nylon and two types of house paint were exposed at nine sites of the Regional Air Monitoring System in the St. Louis area. Wind speed and direction, temperature, dew point, total sulfur, SO2, H2S, O3, NOx, total hydrocarbons, total suspended particulate matter, sulfate and nitrate were recorded. For galvanized steel a pronounced effect of time of first exposure was observed. The corrosion behavior of weathering steel was not seasonally dependent. House paint showed discontinuous erosive behavior. Exposure to the south was more erosive than exposure to the north. Rates for latex paint were higher than for oil based paint. The erosion rate of marble decreased with time. At some sites 50% reflectance loss of silver occurred after 3 months exposure. All samples of A1 7079 at 25 Ksi failed in less than 255 days, while complete failure at 15 Ksi occurred between 277 and 630 days. For A1 2014 more scatter was observed. The pollution levels in St. Louis were found to be rather low. Ozone showed similar seasonal changes as the temperature. Sites close to the center of St. Louis had lower ozone but higher NOx and total hydrocarbon levels. Sulfate was about twice as high in summer as in winter. A first attempt at multiple regression analysis was made. Apparent inconsistencies in the estimated effects are believed to be due to multicollinearity.

30942 (PB—81-128837) Novel concepts for recovery of nuclear grade zirconium oxide from Bureau of Mines zirconyl chloride strip liquors. Final report, October 1979-March 1980. Stambuagh, E.P.; Miller, J.F.; Smith, R.K. (Battelle Columbus Labs., OH (USA)). Jun 1980. Contract J0295067. 62p. NTIS, PC A04/MF A01.

Results of research on the hydrothermal precipitation of zirconium oxide from the Bureau of Mines zirconyl chloride-sulfate strip liquors indicate that nuclear-grade material can be prepared by this process. Greater than 99 pct of the zirconium value can be precipitated at 250 to 260 C in short reaction time without consumption of acid value of the liquor. Thus, precipitation of zirconium dioxide on a continuous basis, that is, the zirconium dioxide is precipitated in a continuous mode of operation by pumping the strip liquor through a heated pressurized reactor and recycle of the acidic liquor to the process stage are favored. The results of accompanying studies of liquid-solid separation, product washing and dewatering, product purity, and chlorination of the product are presented and discussed.

30943 (PNL—3569) Corrosion resistance of cast irons and titanium alloys as reference engineered metal barriers for use in basalt geologic storage: a literature assessment. Charlot, L.A.; Westerman, R.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1981. Contract AC06-76RL01830. 72p. NTIS, PC A04/MF A01. Order Number DE81026840.

A survey and assessment of the literature on the corrosion resistance of cast irons and low-alloy titanium are presented. Selected engineering properties of cast iron and titanium are briefly described; however, the corrosion resistance of cast iron and titanium in aqueous solutions or in soils and their use in a basalt repository are emphasized. In evaluating the potential use of cast iron and titanium as structural barrier materials for long-lived nuclear waste packages, it is assumed that titanium has the general corrosion resistance to be used in relatively thin cross sections whereas the cost and availability of cast iron allows its use even in very thick cross sections. Based on this assumption, the survey showed that: The uniform corrosion of low-alloy titanium in a basalt environment is expected to be extremely low. A linear extrapolation of general corrosion rates with an added corrosion allowance suggests that a 3.2- to 6.4-mm-thick wall may have a life of 1000 yr. Pitting and crevice corrosion are not likely corrosion modes in basalt ground waters. It is also unlikely that stress corrosion cracking (SCC) will occur in the commercially pure (CP) titanium alloy or in palladiumor molybdenum-alloyed titanium materials. Low-alloy cast irons may be used as barrier metals if the environment surrounding the metal keeps the alloy in the passive range. The solubility of the corrosion product and the semipermeable nature of the oxide film allow significant uniform corrosion over long time periods. A linear extrapolation of high-temperature corrosion rates on carbon steels and corrosion rates of cast irons in soils gives an estimated metal penetration of 51 to 64 mm after 1000 yr. A corrosion allowance of 3 to 5 times that suggests that an acceptable cast iron wall may be from 178 to 305 mm thick. Although they cannot be fully assessed, pitting and crevice corrosion should not affect cast iron due to the ground-water chemistry of basalt.

30944 (SAND—81-0365C) Properties of matter at ultra-high pressures. Perry, F.C.; Sweeney, M.A.; Asay, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 4p. (CONF-810827—2). NTIS, PC A02/MF A01. Order Number DE81026504.

From 8. AIRAPT conference and 19. EHPRG conference; Uppsala, Sweden (17 Aug 1981).

Some recent experiments using the precision impact technique to study the shock-induced vaporization of lead (Pb) are described. Previous experiments have utilized strong shock waves to investigate the equation of state of lead and other metals. Emphasis here is on the possibility of direct observation of rate or kinetic effects in such phase transitions, and it is believed that the highly resolved diagnostics are capable of revealing these effects.

30945 (SAND—81-8185) final report on low-cycle fatigue and creep-fatigue testing of steam-filled alloy 800 specimens. Kaae, J.L. (Sandia Labs., Albuquerque, NM (USA)). Feb 1981. Contract AC04-76DP00789. 44p. NTIS, PC A03/MF A01. Order Number DE81028255.

Uniaxial low-cycle fatigue and creep-fatigue tests have been carried out on hollow alloy 800 specimens that were filled with steam. Two testing temperatures were employed, each with its own steam condition. These temperatures and steam conditions were 650°F with saturated steam (5% liquid, 95% vapor) and 1200°F with superheated steam at 2200 psi. The low-cycle fatigue tests were carried out at both 650°F and 1200°F by cycling the strain between equal tensile and compressive magnitudes until specimen failure or until it was no longer practical to continue the test. The creep-fatigue tests were carried out to failure by cycling the strain in the same fashion as in the low-cycle fatigue tests but with holds imposed at either the peak tensile strain or the peak compressive strain or at both peak tensile and compressive strains in each loading cycle.

30946 (SAND—81-8229) Mechanical properties and microstructure of hot isostatically pressed HP9-4-20 steel powder. Klimowicz, T.F. (Sandia National Labs., Livermore, CA (USA)). Jun 1981. Contract AC04-76DP00789. 24p. NTIS, PC A02/MF A01. Order Number DE81028685.

Hot Isostatic Pressing (HIP) is a relatively new technique in which fully dense near-net-shape parts can be produced by the consolidation of metallic powders at high temperatures (~ 900 to 1200°C) and high pressures (15 to 30 KSI). One material which may beneficially utilize the first two advantages of HIP (the materials and machining savings) is HP9-4-20, a high strength martensitic steel. This steel offers a very attractive combination of strength, toughness, and weldability. Unfortunately, because of its rather high alloy content (9 pct. Ni and 4 pct. Co), HP9-4-20 is quite expensive. An investigation of the mechanical properties and microstructures that are obtained by the HIPing of HP9-4-20 steel powder is described.

30947 (SERI/CP—633-1145, pp 57-61) Environmental cracking of containment alloys in molten salts. Dawson, D.B. (Sandia National Labs., Livermore, CA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

The environmental cracking behavior of containment materials in molten nitrate salts is being explored with a series of tests. Slow Strain Rate screening tests (SSRT) conducted at strain rates from 10^{-4} to 10^{-7} per second, over a temperature range from 300 to 630°C, do not show evidence of environmental cracking of Incoloy

800 exposed to molten draw salt (60% $NaNO_3$/40% KNO_3). The SSRT screening matrix will now be extended to include a wider range of environmental and metallurgical variables relevant to solar operation. Environmental cracking tests involving cyclic strain and temperature are also in progress. These studies will help to provide the basis for determining the direction and scope of further environmental cracking tests. At this point, there is no evidence to show that environmental cracking will cause any impediment to the development of molten salt-cooled solar receiver systems.

30948 (SERI/CP—633-1145, pp 63-70) **Corrosion of 9 chrome 1 moly and 316 L stainless steel alloys.** Lee, S.T.; Hong, Y.K.; Ahn, J.H.; Pitt, C.H.; Wadsworth, M.E. (Univ. of Utah, Salt Lake City). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

Research has been initiated to study the effects of thermal cycling on the corrosion resistance of alloys which could be candidates for use in solar thermal energy boilers. The alloys chosen for study were 316 L stainless steel and an iron base 9 Cr 1 Mo alloy. The corrosion resistance of these alloys is determined primarily by the formation of an extremely thin (2 to 10 nm thick) passive films on the surface of the alloy. The technique chosen for this study is the use of potentiostatic and galvanostatic methods to measure film formation and growth. Auxiliary techniques used to analyze the film composition are Auger spectroscopy and ESCA (electron spectroscopy for chemical analysis). Also, anodic polarization curves are obtained.

30949 (UCLA—34P172-5) **Isotropic fiber coarsening in unidirectionally solidified eutectic alloys.** Ardell, A.J. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Oct 1971. Contract AT03-76ER70172. 27p. (UCLA-ENG—7170). NTIS, PC A03/MF A01.

A theory of coarsening has been developed for the case of fibers of circular cross section in unidirectionally solidified eutectic alloys. The fibers are assumed to be randomly distributed throughout the unoccupied space in the matrix (uniformly distributed), and diffusion of solute is assumed to occur under steady-state conditions with cylindrical symmetry. The theory predicts that the cube of the average fiber radius increases linearly with time for all fiber volume fractions. As the volume fraction increases, the coarsening rate increases and the theoretical distribution of fiber radii becomes broader. It is shown that isotropic fiber coarsening occurs at approximately half the rate at which the same phase would coarsen if it were in the form of spherical precipitates for volume fractions up to 0.6. It is also demonstrated that the fibers will coarsen at a faster rate when they are uniformly distributed than when they are arranged on an hexagonal lattice.

30950 (UCLA-ENG—7214) **Particle-size-distribution effects in precipitation hardening. Third annual progress report, February 1, 1971-December 31, 1971.** Ardell, A.J. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jan 1972. Contract AT03-76ER70172. 40p. (UCLA—34P172-7). NTIS, PC A03/MF A01.

Theoretical work on the diffusion-controlled coarsening of spherical precipitates, grain-boundary precipitates, and fibers in unidirectionally solidified eutectics was completed. Several theoretical problems involving nearest neighbor particle spacings were solved and a unified method for describing the theoretical cumulative distribution functions associated with the three coarsening processes was developed. Experimental data on the coarsening of γ' precipitates in aged Ni-Cr-Al alloys show that there is no effect of volume fraction on the γ' coarsening kinetics, in contradiction to our earlier work on these same alloys. The new results are a consequence of improved statistical measurements and computer processing of the raw data. The initial observations on γ' coarsening in bimodal distributions are described. It is shown that a minimum γ' coarsening in bimodal distributions are described. It is shown that a minimum γ' particle spacing for the class I precipitates (which form on aging at 800°C) is necessary in order for class II γ' precipitates (which form on reaging at 600°C) to exist. For small spacings the γ' particle size distributions remain unimodal. Reasons for this behavior are discussed. Results on sinusoidal aging of γ/γ' alloys show that sinusoidal aging accelerates the growth rate of the average γ' particle. The influence of amplitude and frequency is described.

30951 (UCRL—83050) **Positron lifetime and Doppler broadening techniques applied to irradiation-damaged silver.** Howell, R.H. (Lawrence Livermore National Lab., CA (USA)). 27 Jul 1981. Contract W-7405-ENG-48. 12p. (CONF-800205—16). NTIS, PC A02/MF A01. Order Number DE81028688.

From American Institute of Metallurgical Engineers meeting; Las Vegas, NV, USA (Feb 1980).

Positron lifetime and Doppler broadening measurements have been used to study defect production resulting from room temperature irradiation of pure silver by D-T fusion neutrons or energetic protons. Use of the positron annihilation analysis has established that the surviving defects from both irradiations have the same dose dependence and that defect concentration can be quantitatively measured and compared to damage models. The relative merit of the lifetime and Doppler broadening measurements in arriving at these conclusions is discussed in this report along with some practical aspects of the measurements. In the proton damaged samples the trapping rate approaches saturation, a circumstance which could be misinterpreted if a less extensive data set containing only Doppler broadening data were available. Some remarks about the analysis of positron data and general conclusions about the defect structure are given. 3 figures.

30952 (UCRL—85818) **Welding of austenitic stainless steels for liquid-helium service.** Dalder, E.N.C. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 15p. (CONF-8003144—1). NTIS, PC A02/MF A01. Order Number DE81025602.

From Conference on MHD magnets; Boston, MA, USA (10 Mar 1980).

This survey covers available information on the 4°K mechanical and metallurgical behavior of austenitic stainless steel weldments with particular emphasis on the problems inherent in the production of defect-free welds in structures up to 5 inches thick. Austenitic Cr-Ni, Cr-Ni-N_2, and Cr-Ni-Mn-N_2 stainless steels are the most widely used structural materials in superconducting magnets. These materials show useful combinations of toughness, stiffness, and strength at 4°K. High construction costs and the need for careful composition-control to insure microstructural stability under operational conditions are the principal drawbacks. 11 figures, 4 tables.

30953 (UCRL—86484) **Shock anomaly and s-d transition in high-pressure lanthanum.** McMahan, A.K.; Skriver, H.L.; Johansson, B. (Lawrence Livermore National Lab., CA (USA); Research Establishment Risoe, Roskilde (Denmark); Aarhus Univ. (Denmark). Inst. of Physics). 23 Jul 1981. Contract W-7405-ENG-48. 7p. (CONF-810828—2). NTIS, PC A02/MF A01. Order Number DE81027659.

From Conference on high pressure physics; Bad Honnef, F.R. Germany (Aug 1981).

Linear-muffin-tin orbital calculations of the band structure and pressure-volume isotherms for fcc La, both at zero and finite temperatures. The calculated bulk modulus shows a rapid stiffening in the range from 40 to 50% compression, due to termination of the 6s to 5d electronic transition. When combined with a simple Slater model analysis, these results yield a temperature dependent peak in the lattice Grueneisen parameter. Experimental confirmation of this peak is found in an anomalous stiffening seen in the shock compression data for La, and it may also have some bearing on the observed saturation of the superconducting transition temperature in La around 200 kbar.

30954 (UCRL—86514) **Optical polishing of metals.** Brown, N.J.; Baker, P.C.; Maney, R.T. (Lawrence Livermore National Lab., CA (USA)). 29 Jul 1981. Contract W-7405-ENG-48. 16p. (CONF-810810—17). NTIS, PC A02/MF A01. Order Number DE81028690.

From SPIE international symposium; San Diego, CA, USA (24 Aug 1981).

A polishing model and a fixed charge lap model are presented. Optical polishing data is presented for 11 metals partially supporting the above. 11 figures.

30955 **Deuterium in He-implanted Fe: trapping and the surface permeation barrier.** Myers, S.M.; Besenbacher, F.; Bottiger, J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Applied Physics Letters ;* **39**: No. 5, 450-452(1 Sep 1981).

Deuterium (D) and He were ion-implanted into Fe, and the D depth distribution was monitored during linear ramping of temperature. Defects associated with He, possibly small bubbles, were observed to trap the D with an enthalpy of 0.75 +- 0.07 eV. The previously air-exposed Fe surface was a substantial permeation barrier to D: data analysis yielded a recombination coefficient of 10/ sup -18plus-or-minus0.7/ cm⁴/sec at 500 K.

30956 **Interpretation of shock-wave data for beryllium and uranium with an elastic-viscoplastic constitutive model.** Steinberg, D.J.; Sharp, R.W. Jr. (University of California, Lawrence Livermore National Laboratory, Livermore, California). *Journal of Applied Physics ;* **52**: No. 8, 5072-5083(Aug 1981).

We have developed a new elastic-viscoplastic constitutive model for metals which can easily be incorporated into a one-dimensional Lagrangian hydrodynamic computer code. Rather than the usual constant relaxation time, we have used one which is a function of temperature (i.e., thermal energy) and strain rate. This allows us to successfully calculate shock-wave profiles, including the effect of spall, in beryllium and uranium over a wide range of stress, temperature, strain, and strain rate.

30957 **Experimental determination of the phonon and electron components of the thermal conductivity of bcc iron.** Williams, R.K.; Yarbrough, D.W.; Masey, J.W.; Holder, T.K.; Graves, R.S. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Journal of Applied Physics ;* **52**: No. 8, 5167-5175(Aug 1981).

A study of the factors which affect the thermal conductivity of αFe and its solutions is described. The results of these experiments define the phonon and electronic components of the thermal conductivity of pure αFe fairly well between 90 and 400 K. Also, the phonon conductivity can be analyzed to identify the strengths of electron-phonon and phonon-phonon scattering, and the latter resistance is in good agreement with theoretical estimates. The scattering of phonons by electrons is intermediate between the small values for noble metals and the strong scattering found in Nb and Ta. An experimental estimate of the electron-phonon mass enhancement factor, 0.4, is derived from the results. Finally, reexamination of the data for ten solid solution alloys suggests that both phonon-scattering mechanisms are influenced by the alloying elements.

30958 **Self-consistent electronic structure of the intermetallic compound LiAl.** Asada, T.; Jarlborg, T.; Freeman, A.J. (Department of General Education, College of Engineering, Shizuoka University, Hamamatsu, Shizuoka 432, Japan). *Physical Review [Section] B: Condensed Matter ;* **24**: No. 2, 510-516(15 Jul 1981).

The electronic structure of the intermetallic compound LiAl, which has a B32 structure, has been studied by a self-consistent linear-muffin-tin-orbital method within the atomic-sphere approximation and in the local-density formalism. The overall band structure and density of states have a reasonable resemblance with those obtained previously by Zunger, except for several important differences near the Fermi energy. Whereas our results for ideal LiAl give poor agreement with experiments on real ("vacancy-defect") LiAl, we obtain much better agreement after accounting for the presence of vacancies by shifting the Fermi level in a crude rigid-band manner corresponding to the vacancy concentration of roughly two percent estimated experimentally: The shifted results give satisfactory agreement with magnetic-susceptibility and Knight-shift experiments and predict p-type conduction for the real "defect-phase" LiAl, in agreement with recent experimental findings.

30959 **Self-diffusion in chromium.** Mundy, J.N.; Hoff, H.A.; Pelleg, J.; Rothman, S.J.; Nowicki, L.J.; Schmidt, F.A. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter ;* **24**: No. 2, 658-665(15 Jul 1981).

Self-diffusion in chromium single crystals has been measured over the temperature range 1073 to 1466 K. These data, when combined with earlier measurements from this laboratory over the range 1370—2090 K, yield a plot of ln D vs 1/T, which is straight over ten orders of magnitude in the diffusion coefficient D. The high values of the pre-exponential factor (1280 +- 230 $cm^2 s^{-1}$) and activation enthalpy (4.58 +- 0.03 eV) are not readily interpreted in terms of a specific diffusion mechanism. They appear to be too high to be interpreted in terms of a monovacancy mechanism. The possible contribution of divacancies and self-interstitials are discussed.

30960 **Lattice dynamics of hcp Hf.** Stassis, C.; Arch, D.; McMasters, O.D.; Harmon, B.N. (Ames Laboratory, U. S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). W-7405-ENG-82; WPAS-KC-02-02-01. *Physical Review [Section] B: Condensed Matter ;* **24**: No. 2, 730-740(15 Jul 1981).

Inelastic neutron scattering techniques have been used to study the lattice dynamics of hcp Hf. The phonon dispersion curves along the [001], [100], and [110] symmetry directions were determined at 295 and 1300 K, and a selected number of phonon frequencies were measured also at 800 K. As the temperature decreases we observe a rather large increase in the frequencies of all but the [001] LO branch. The zone-center mode of the [001] LO branch, on the other hand, softens appreciably, and at room temperature this branch exhibits a dip at the zone center. These features of the phonon dispersion curves of Hf are similar to those of hcp Zr and Ti. The data were used to evaluate the lattice specific heat at constant pressure as a function of temperature. The calculated total specific heat, obtained by taking into account the electronic contribution, was found to agree, to within experimental uncertainties, with the results of specific-heat measurements. We find that the phonon anomalies (and their temperature dependence) in the dispersion curves of the superconducting elements of the IV column of the periodic table can be understood qualitatively as originating from the splitting about the Fermi level of doubly degenerate bands by the lattice distortion corresponding to the [001] LO mode. We argue that this mechanism may also be responsible for the phonon anomalies observed in other superconducting elements (Tc) and compounds ($LaSn_3$).

30961 **Electronic structure and local atomic configurations of flat and stepped (111) surfaces of Ni and Cu.** Tersoff, J.; Falicov, L.M. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter ;* **24**: No. 2, 754-764(15 Jul 1981).

Results of self-consistent linear-combination-of-atomic-orbitals calculations for ideal and stepped (111) surfaces of Ni and Cu are presented. They are related to catalytic activity by a simple physical picture. The d band is decomposed into a "local" d band at each site. The width, position, and occupancy of this local d band show simple trends as a function of site coordination. For Ni (and similarly, for Pt) sites of highest coordination tend to be the most active sites on a surface, provided they are accessible to adsorbate molecules. Copper shows little activity, regardless of site coordination.

30962 **Effect of pressure on the Fermi surface of Nb_3Sb.** Schirber, J.E.; Arko, A.J.; Fisk, Z. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Physical Review [Section] B: Condensed Matter ;* **24**: No. 2, 1089-1090(15 Jul 1981).

The pressure dependences of three cross sections of the Fermi surface of Nb_3Sb are determined from de Haas—van Alphen measurements in solid He to several kbar. A large negative derivative is observed for the smallest cross section of the hole ellipsoid at M.

30963 Temperature dependence of helium release from erbium tritide films. Mitchell, D.; Patrick, R. (Applied Physics Division 2353, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology ;* **19**: No. 2, 236-242(Jul 1981).

The rates of helium release from ErT_2 films were measured during constant temperature storage (ranging from 77—500 K) and following abrupt temperature changes. Large changes in helium release rates were measured immediately following the temperature changes; however, the helium release rates were only slightly temperature dependent following the initial transient response. The helium concentration which corresponds to the onset of accelerated release is found to be a function of temperature for ErT_2 films. It is also shown that an ErT_2 film that is in accelerated release can be made to release helium at a low rate after decreasing the helium concentration by means of a high-temperature cycle.

30964 Process for stabilizing dimensions of duplex stainless steels for service at elevated temperatures. Hull, F.C.; Tobin, J.C. (to Dept. of Energy). US Patent 4,263,063. 21 Apr 1981. Filed date 5 Jul 1979. vp.

Duplex stainless steel materials containing austenite plus delta ferrite, are dimensionally stabilized by heating the material to a reaction temperature between about 1050°-1450° F. (566°-788° C.), holding it at this temperature during transformation of delta ferrite to austenite plus sigma phase, and subsequently heating to a reversion temperature between about 1625°-1750° F. (885°-954° C.), whereby the sigma phase transforms back to ferrite, but the austenite remains dispersed in the ferrite phase. Final controlled cooling permits transformation of ferrite to austenite plus sigma and, later, precipitation of carbides.

30965 Low mn alloy steel for cryogenic service and method of preparation. Morris, J.W.; Niikura, M. (to Dept. of Energy). US Patent 4,257,808. 24 Mar 1981. Filed date 13 Aug 1979. vp.

A ferritic cryogenic steel which has a relatively low (About 4-6%) manganese content and which has been made suitable for us at cryogenic temperatures by a thermal cycling treatment followed by a final tempering. The steel includes 4-6% manganese, 02-0.06% carbon, 0.1-0.4% molybdenum and 0-3% nickel.

30966 Carbon and nitrogen transfer in Fe-9 Cr-Mo ferritic steels exposed to a sodium environment. Chopra, O.K.; Natesan, K.; Kassner, T.F. (Argonne National Lab., IL (USA). Materials Science Div.). *Journal of Nuclear Materials ;* **96**: No. 3, 269-284(Feb 1981).

Kinetics of carburization/decarburization of five commercial and two high-purity Fe-9 Cr-1 to 2.5 Mo ferritic steels have been studied in a sodium environment at temperatures between 773 and 973 K. Carbon concentration-distance profiles were obtained as a function of sodium-exposure time, temperature, and carbon in sodium and the carburization/decarburization rate constants were evaluated. The results show that the Fe-9 Cr-Mo steels are more resistant to carbon transfer than the low-alloy Fe-2/4 Cr-1 Mo steel. The conditions of temperature and carbon concentration in sodium for carburization or decarburization of Fe-9 Cr-Mo steels are quite similar to those for stainless steels. However, the extent of carbon transfer in Fe-9 Cr-Mo steels is lower than that of the stainless steels. The composition and carbide structure of the steel had a significant effect on the carburization/decarburization behavior. Fe-9 Cr-Mo steels that decarburize to very low carbon concentrations either contain M_2X phase or have M_6C as the only stable carbide.

30967 Application of endochronic theory in multi-dimensional stress states. Hsieh, B.J. (Argonne National Lab., IL (USA). Components Technology Div.). *Nuclear Engineering and Design ;* **63**: No. 1, 143-155(Jan 1981).

The general endochronic theory and its specific constitutive equations for different stress states are studied. The determination of the material parameters, the stability and uniqueness of solution to an endochronic model are also examined. The endochronic material parameters can not be obtained by explicit means from simple tension test data. An approximate formula for these parameters is proposed. It is used to study the transverse behavior of a rod subjected to a uniaxial stress state and the behavior of a plate subjected to an in-plane biaxial stress state under static condition. Results for applications to dynamic problems are also reported. It is found that the endochronic model with simple relaxation function can be applied successfully to certain problems, although it may exhibit undesirable behavior for other problems. The flexibility in describing various material phenomena can be improved by using more realistic relaxation function and intrinsic time definition. This theory has great potential in practical applications.

30968 Magnetic susceptibility of ^{248}Cm metal. Huray, P.G.; Nave, S.E.; Peterson, J.R. (Oak Ridge National Lab., TN (USA). Transuranium Research Lab.); Haire, R.G. (Oak Ridge National Lab., TN (USA). Transuranium Research Lab.). *Physica B+C (Amsterdam) ;* **102**: No. 1-3, 217-220(Oct-Dec 1980).

A SQUID-based micromagnetic susceptometer has been used to determine the magnetic susceptibility of ^{248}Cm metal in the temperature range 4.2-340 K and in the applied magnetic field range of 0.45-1400 G. X-ray diffraction indicated that two of the samples of mass 37.2 and 41.2 μg exhibit the dhcp phase and one of mass 152 μg the fcc structure. The nominally dhcp samples exhibit an antiferromagnetic transition at approx. 65 K. A small second transition near 200 K is observed and influences the high temperature Curie-Weiss fit to the data. The fcc sample exhibits a ferromagnetic transition in the neighborhood of 200 K and at low temperature has a saturated magnetic moment per atom of 0.4 Bohr magnetons in applied fields above 1200 G. At high temperatures three interpretations of the susceptibility may be made.

30969 Observation of effects of finite specimen geometry on the oxidation kinetics of Zircaloy-4. Pawel, R.E.; Campbell, J.J. (Oak Ridge Natl Lab, Tenn). *Journal of the Electrochemical Society ;* **127**: No. 10, 2188-2194(Oct 1980).

The oxidation of zirconium and zirconium-base alloys at temperatures above the alpha-beta transition involves the growth of layers of oxide and oxygen-stabilized alpha into the host beta phase. If the growth is governed by diffusion processes, the oxidation of thin specimens will exhibit significant variations in the kinetics of layer growth if the duration of the reaction is sufficient to promote large changes in the degree of saturation of the underlying metal with oxygen. The authors have examined this effect for the oxidation of Zircaloy-4 in steam by modeling analyses and by a series of extended-time oxidation experiments at 1300/degree/C. These experiments confirmed the predicted increase in the kinetics of alpha layer growth as the beta phase becomes saturated. For example, at 1300/degree/C, the rate constant increases by more than a factor of 2. 20 refs.

30970 Neutron diffraction analysis of a compositionally modulated alloy of nickel-copper. Felcher, G.P. (Argonne National Lab., IL (USA)); Cable, J.W. (Oak Ridge National Lab., TN (USA)); Zheng, J.Q.; Ketterson, J.B.; Hilliard, J.E. (Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy; Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science and Engineering; Northwestern Univ., Evanston, IL (USA). Materials Research Center). *Journal of Magnetism and Magnetic Materials ;* **21**: No. 2, 198-202(Aug-Sep 1980).

A compositionally modulated Nisub(0.4)Cusub(0.6) alloy, made in a thin film of 1.8 μm thickness, was examined by polarized neutron diffraction. The results show that the material is ferromagnetic, with a large enhancement of the magnetic moment (0.3 μsub(B)/Ni) with respect to a disordered alloy. The behaviour of the magnetic moments gives strong evidence of chemical clustering.

30971 Photoelectron spectroscopy of solids. Watson, R.E.; Perlman, M.L. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Physica Scripta ;* **21**: 527-534(1980).

Information about electronic structure and bonding in solids which can be derived from valence band and core level photoelectron spectroscopy is presented here. The role, in research of this kind, of the excitation processes discussed elsewhere in this symposium is of concern. A number of factors contribute to the apparent chemical shifts of core levels and valence bands in solids. These factors are considered and then results for gold alloys are taken as

an example of the bonding information which can be derived. Angle resolved photoelectron spectroscopy provides information about wave function symmetry as well as energy. This is reviewed and one-electron energy vs k results for Ni metal are inspected. Such results provide the best experimental test yet devised of energy band theory and of the potentials employed.

30972 Effects of radiation on structural materials. Sprague, J.A.; Kramer, D. (eds.). Philadelphia, PA; American Society for Testing and Materials (1979). 684p. (ASTM-STP—683; CONF-780722—). $58.50.

From 9. symposium on effects of radiation in structural materials; Richland, WA, USA (10 Jul 1978).

Separate abstracts were prepared for two of the included papers. Abstracts for the remaining papers were previously entered into the data base. (MOW)

30973 Determination of the nature of neutron irradiation-induced dislocation loops in magnesium using electron irradiation in the transmission electron microscope. Wolfenden, A. *Annual Book of ASTM (American Society for Testing and Materials) Standards ;* 5-11(1979).

Magnesium single crystals were irradiated to 2.1 x 10^{21} neutrons (n)/cm^2 (E > 0.1 MeV) near 450°K, one set of specimens being under a compressive stress of 80 MPa applied in the c-direction. A transmission electron microscopy (TEM) investigation of the crystals irradiated under load showed that the neutron damage consisted of dislocation loops. Under in situ electron irradiation in the TEM at 200 kV, some of these loops were observed to shrink. It was deduced that the shrinking loops were of the vacancy type, which is consistent with theoretical predictions of the influence of an external compressive stress on dislocation loop formation during irradiation.

30974 Radiation effects on molybdenum alloys bombarded by electrons in a high-voltage electron microscope. Igata, N.; Kohyama, A.; Itadani, K. (Univ. of Tokyo, Japan). *Annual Book of ASTM (American Society for Testing and Materials) Standards ;* 12-31(1979).

The objective of this study is to clarify the dislocation loop formation and the subsequent void swelling and also to reconsider the use of the high-voltage electron microscope (HVEM) as simulation study for neutron or other particle irradiation. In situ observation of damage processes in molybdenum carbon alloys was performed by HVEM in the temperature range between 300 and 1300 K with the dose level up to 10 displacements per atom (dpa). Dislocation loop density was observed as the function of irradiation temperature. Below 500 K the density was interpreted to mean that the nuclei for interstitial clusters are di-interstitials. Above 500 K, however, the instability of the interstitial clusters was observed. The dislocation loop formation and the succeeding dislocation behavior were observed above 1000 K and four stages were observed. Void swelling was observed after the dislocation density reached steady state. The effect of the surface on dislocation behavior was found to be very important. The void swelling was proportional to the third power of irradiation time, similar to other irradiation data.

30975 Zirconium in the nuclear industry. Papazoglou, T.P. (ed.). Philadelphia, PA; American Society for Testing and Materials (1979). 627p. (ASTM-STP—681; CONF-780637—). $52.50.

From 4. symposium on zirconium in the nuclear industry; Stratford-on-Avon, UK (27 Jun 1978).

Separate abstracts for each paper were entered earlier into the data base. (MOW)

30976 (HEDL—6851) HEDL contribution to DAFS HFIR irradiation of representative path B alloys. Peterson, D.T.; Powell, R.W. (Hanford Engineering Development Lab., Richland, WA (USA)). [nd]. Contract AC14-76FF02170. 4p. NTIS, PC A02/MF A01. Order Number DE81026508.

Specimens of path B alloys (developmental precipitation strengthened Fe—Ni—Cr alloys) have been included in the HFIR irradiations. They will be irradiated to 10, 20, and 40 dpa. (DLC)

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REFER ALSO TO CITATION(S) 29846, 30019, 30053, 30592

30977 (DOE/ER/01198—1357) Ultrasonic attenuation and velocity studies in the α-α' solid solution phases of the Nb-H system. Mazzolai, F.M.; Birnbaum, H.K. (Illinois Univ., Urbana (USA). Materials Research Lab.). 1981. Contract AC02-76ER01198. 7p. (CONF-8106105—1). NTIS, PC A02/MF A01. Order Number DE81026618.

From International conference on internal friction and acoustic attenuation of solids; Lausanne, Switzerland (Jun 1981).

Data are reported on the elastic constants and ultrasonic attenuation of a single crystal of Nb determined as a function of the hydrogen content ($0 \leqq H/Nb \leqq 0.71$) at 528°K and as a function of temperature ($380° \leqq T \leqq 528°K$) for H/Nb = 0.31, 0.45, 0.53, and 0.71. A relaxation process is observed which appears to be a Zener-type of effect. 6 figures.

30978 (DOE/ER/01198—1360) Chemical-vapor deposition of materials in the silcon-aluminum-carbon-nitrogen system. Willkens, C.A. (Illinois Univ., Urbana (USA)). 1981. Contract AC02-76ER01198. 100p. NTIS, PC A05/MF A01. Order Number DE81028878.

Thesis.

Chemical vapor deposition of silicon carbide from gaseous mixtures of CH_3SiCl_3,H_2,$SiCl_4$ and $(CH_3)_2SiCl_2$ was examined at temperatures ranging from 1200 to 1750°C. The coating rate was observed to increase with temperature, CH_3SiCl_3 concentration and $CH_3SiCl_3/SiCl_4$ ratios. In addition, the codeposition of condensed phases from CH_3SiCl_3 and $AlCl_3.NH_3$ gases were examined at 1200°C as a function of $CH_3SiCl_3/AlCl_3.NH_3$ (MTS/ACN) mole ratio. Nomially pure AlN could be formed for ratios of MTS/ACN $\leqq$ 0.1. Mixtures of AlN and polycrystalline α-Si_3N_4 formed for gas mixtures of $0.1 \leqq$ MTS/ACN $\leqq 1$. Amorphous Si_3N_4 (with traces of free silicon) formed for cases where $1 \leqq$ MTS/ACN $\leqq 10$. Finally, mixtures of free silicon and β-SiC were found for gas mixtures of MTS/ACN $\leqq 10$. AlN which has the 2H wurtzite structure serves to nucleate α-Si_3N_4 which otherwise forms as an amorphous deposit.

30979 (DOE/ER/04998—T1) Grain boundary diffusion and grain boundary chemistry of Cr-doped magnesium oxide. Technical progress report. Stubican, V.S. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). 15 Jul 1981. Contract AS02-78ER04998. 40p. NTIS, PC A03/MF A01. Order Number DE81028314.

The grain boundary product $D' \delta$ (where D' is the grain boundary diffusion coefficient and δ is the grain boundary width) of ^{51}Cr in MgO and Cr-doped MgO was determined at 1200 to 1450°C for Cr^{3+} concentrations of 0 to 0.56 atom %. By assuming a grain boundary width to be between 100 and 1000 A the grain boundary diffusion coefficients are 10^5-10^6 times larger than the volume diffusion coefficients. $D' \delta$ increased with increasing Cr^{3+} concentration, but the activation energy for diffusion of 180 +- 8 kJ/mole was the same for all specimens. Surface diffusion on MgO and Cr-doped MgO was examined using grain boundary grooving at 1100 to 1400°C for a concentration range of 0 to 0.211 atom % chromium. The activation energy for surface diffusion on MgO was found to be 239 +- 5 kJ/mole. The surface diffusivity did not change markedly with chromium concentration; however, an abrupt change in activation energy from 180 kJ/mole occurred between 0.038 and 0.254 atom % chromium. Effect of association of defects on the thermodynamical factor (Darken's equation) for diffusion was studied theoretically. It was shown that in the limit of dilute solution the thermodynamic factor $(1 + \partial \ln \gamma / \delta \ln N)$ was equal to 3/2 if monomers are the diffusing species, 2 if dimers are the diffusion species and 3 if trimers are the diffusion species. These results are consistent with the atomistic model.

30980 (LA-UR—81-2078) Structural properties of MgO and $MgAl_2O_4$ after fission neutron irradiation near room temperature. Hurley, G.F.; Kennedy, J.C.; Clinard, F.W. Jr.; Youngman, R.A.; McDonnell, W.R. (Los Alamos National Lab., NM (USA); Case Western Reserve Univ., Cleveland, OH (USA); Savannah River Ecology Lab., Aiken, SC (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810831—6). NTIS, PC A02/MF A01. Order Number DE81028770.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Polycrystalline MgO and $MgAl_2O_4$ samples were irradiated at 430 +- 5 K in HFIR to a fast neutron fluence of 2.1 x 10^{26} n/m^2, E > 0.2 MeV, and 4.6 x 10^{26} thermal n/m^2. Following irradiation, swelling, microstructure and mechanical strength were evaluated relative to control samples. Both materials swelled substantially, 2.6-3.0% in the case of MgO, and 0.8% in the case of $MgAl_2O_4$. The substructure of the MgO was found to contain a dense array of dislocation loops while the spinel showed heavy but unresolved damage. Results of mechanical strength evaluation by diametral compression testing showed significant strengthening for both materials. This result, which has important implications for use of cubic technological ceramics, is discussed in terms of the observed fracture modes and microstructural damage.

30981 (ORNL/TM—7280) Preliminary development of internal gelation flowsheets for preparing $(Th,U)O_2$ spheres. Haas, P.A.; Spence, R.D.; Stinton, D.P. (Oak Ridge National Lab., TN (USA)). Aug 1981. 63p. NTIS, PC A04/MF A01. Order Number DE81025663.

Internal gelation procedures were developed to prepare good, high-density $(Th,U)O_2$ spheres, 800- to 1200-μm in diameter, as required for Sphere-Pac fabrication of nuclear fuels. Decomposition of hexamethylenetetramine (HMTA) dissolved in metal nitrate solution drops releases ammonia to solidify or gel the drops as hydrated metal oxides. The thorium-uranium nitrate feed solutions were made acid deficient by partial neutralization with NH_4OH or by solvent extraction of nitrate. For some feeds, gelation of drops was in trichloroethylene at 60 to 75°C. Feeds with high concentrations of urea as a complexing agent for metals required higher temperatures and were gelled in perchloroethylene-mineral oil mixtures at 80 to 95°C. Slow changes of concentration during washing with ammonia were important to prevent cracking of the 800- to 1200-μm sintered spheres. The spheres were dried in steam atmospheres, calcined and then sintered in Ar-4% H_2 at 1450°C to give $(Th,U)O_2$ spheres with nearly theoretical density (≧ 99%). The initial batches prepared with other washing and drying procedures showed severe cracking.

30982 Fermi surface of ReO_3 above the "compressibility-collapse" transition. Schirber, J.E.; Mattheiss, L.F. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *B: Condensed Matter ;* **24**: No. 2, 692-697(15 Jul 1981).

The ReO_3 Fermi surface above the pressure-induced "compressibility-collapse" transition is derived from the simple-cubic band structure, assuming T^5/sub h/(Im3) symmetry for the distorted phase. A new set of closely spaced de Haas—van Alphen (dHvA) frequencies have been observed which are consistent with this model. Magnetic-breakdown effects dominate the dHvA data at higher magnetic fields. As a result, only three relatively low frequencies, all involving orbits on the new first-zone hole surface, have been detected thus far.

30983 Subsolidus phase relations in the systems CeO_2-RE_2O_3 (RE_2O_3 = C-type rare earth sesquioxide). Pepin, J.G. (Pennsylvania State Univ., University Park); Vance, E.R.; McCarthy, G.J. Contract AC09-79ET41900. *Journal of Solid State Chemistry ;* **38**: No. 3, 360-367(15 Jul 1981).

The systems CeO_2-RE_2O_3 (RE_2O_3 = C-type rare earth sesquioxide) were studied to: (1) investigate the claims of several workers for the existence of a complete solid solution series between CeO_2 and RE_2O_3; and (2) to characterize the weak C-type x-ray diffraction peaks reported by others from samples in the single-phase fluorite solid solution region. It is shown that a complete solid solution series does not exist, and an explanation for the observations of others reporting such is tendered. It is also shown that the observation of C-type reflections in the supposed single-phase fluorite field can be attributed to the partial reduction of Ce^{4+} to Ce^{3+} at the firing temperature, resulting in the movement of the bulk composition into a two-phase field of the CeO_2-RE_2O_3-Ce_2O_3 phase diagram, rather than the formation of a domain structure due to ordering.

30984 Neutron irradiations in oxidized lithium-doped MgO crystals. Chen, Y.; Montesa, E.; Boldu, J.L.; Abraham, M.M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Physical Review* [*Section*] *B: Condensed Matter ;* **24**: No. 1, 5-10(1 Jul 1981).

The effect of neutron irradiation on lithium-doped MgO crystals is investigated using optical-absorption and EPR measurements. Unlike electron irradiation, neutron irradiation does not produce stable $[Li]^0$ centers in as-grown MgO:Li crystals. In crystals containing stable $[Li]^0$ centers produced by oxidation at elevated temperatures, neutron irradiation results in a decrease of $[Li]^0$ concentration and the formation of stable V^0, V^-, V/sub OH/, and V/sub F/ centers. The loss of $[Li]^0$ centers is attributed to the recombination of holes from these centers with electrons at multivacancy defects created by neutrons.

30985 Sintering of beta-type alumina bodies using alpha-alumina encapsulation. Mcentire, B.J.; Virkar, A.V. (to Dept. of Energy). US Patent 4,263,381. 21 Apr 1981. Filed date 27 Oct 1978. vp.

A method of sintering a shaped green, beta-type alumina body comprising: (A) inserting said body into an open chamber prepared by exposing the interior surface of a container consisting essentially of at least about 50 weight percent of alpha-alumina and a remainder of other refractory material to a sodium oxide or sodium oxide producing environment; (B) sealing the chamber; and heating the chamber with the shaped body encapsulated therein to a temperature and for a time necessary to sinter said body to the desired density. The encapsulation chamber prepared as described above is also claimed.

30986 Optimization of thorium oxalate precipitation conditions relative to derived oxide sinterability. White, G.D.; Bray, L.A.; Hart, P.E. (Battelle Pacific Northwest Labs., Richland, WA (USA). Materials Dept.). *Journal of Nuclear Materials ;* **96**: No. 3, 305-313(Feb 1981).

The effect of thorium oxalate precipitation conditions on derived oxide sinterability was investigated on a laboratory scale with the objective of producing ThO_2 powder that could be sintered to high density without milling. Precipitation conditions examined were temperature, digestion time and agitation method which were employed in a two-level factorial experimental design to delineate their effects. The two levels for each of the factors, respectively, were 10 and 70°C, 15 min and 360 min, and mechanical stirrer and a homogenizer that imparted both mechanical and ultrasonic agitation. The ThO_2 derived from each of the precipitation trials was characterized with respect to morphology, surface area, and crystallite size as well as sinterability. Only precipitation temperature had a significant effect upon all the properties of the derived oxide powders. The most sinterable oxide was derived from an oxalate precipitated at 10°C with mechanical agitation and 15 min digestion. Pellets formed from this oxide sintered to 96% TD. Physical property data were determined also for mixed oxide derived from coprecipitated thorium-25% uranium (IV) oxalate and thoria from continuously precipitated oxalate.

30987 Local mixing model for deuterium replacement in solids. Doyle, B.L.; Brice, D.K.; Wampler, W.R. (Sandia Labs., Albuquerque, NM (USA)). *Radiation Effects Letters ;* **57**: No. 3, 81-87(Jul 1980).

A new model for hydrogen isotope exchange by ion implantation has been developed. The basic difference between the present approach and previous work is that the depth distribution of the implanted species is included. The outstanding feature of this local mixing model is that the only adjustable parameter is the saturation hydrogen concentration which is specific to the target material and dependent only on temperature. The model is shown to give excel-

lent agreement both with new data on H/D exchange in the low Z coating materials VB_2, TiC, TiB_2, and B reported here and with previously reported data on stainless steel. The saturation hydrogen concentrations used to fit these data were 0.15, 0.25, 0.15, 0.45, and 1.00 times atomic density respectively. This model should be useful in predicting the recycling behavior of hydrogen isotopes in tokamak limiter and wall materials.

30988 **Annual book of ASTM standards. Part 17. Refractories, glass, and other ceramic materials; manufactured carbon and graphite products.** Philadelphia, PA; American Society for Testing and Materials (1980). 1133p. $42.00.

The standards are assembled in each part in alphanumeric sequence of their ASTM designation numbers. Each part has two tables of contents: a list of the standards in alphanumeric sequence of their ASTM designations; and a list of the standards classified according to subject. A subject index of the standards and tentatives in each part appears at the back of each volume. This part contains standards concerning refractories; glass and glass products; ceramic whitewares; porcelain enamel and related ceramic-metal systems; ceramics for electronics; manufactured carbon and graphite products; and general methods of testing.

3603 Composite Materials

REFER ALSO TO CITATION(S) 30231

30989 **(DOE/ER/02407—9) Generalization of internal centrifugal zone growth of metal-ceramic composites and kinetics, morphology and thermodynamics of the solid-liquid transition of non-metals. Final report, December 1, 1973-May 31, 1981.** Sekerka, R.F. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Metallurgy and Materials Science). May 1981. Contract AS02-76ER02407. 12p. NTIS, PC A02/MF A01. Order Number DE81027884.

Work conducted under this contract can be categorized under two headings which have also served as titles: (A) generalization of Internal Centrifugal Zone Growth (ICZG) of Metal-Ceramic composites and (B) Kinetics, Morphology and Thermodynamics of the Solid-Liquid Transition of non-metals. Work under A has been finished and completely documented, resulting in the quantification of fundamental instability phenomena that can occur during the induction heating and melting of ceramics and a model of the ICZG process that can serve to guide the crystal grower in process optimization and adaption to new materials. Theoretical work under B has led to a proof, independent of any statistical model, of the Onsager reciprocal relations for multicomponent diffusion and heat flow in fluids, has developed the fundamental concepts inherent in the existence of constitutive relations, and has paved the way toward extension of these developments to solids and to solid-fluid interfaces.

30990 **(SAND—81-0976) Compocasting of an aluminum alloy composite containing B_4C particulate.** Hosking, F.M. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01. Order Number DE81028185.

A description of the compocasting process is given. Processing of metal matrix composites through the additions of nonmetallic particulate into a partially solidified, vigorously agitated metallic slurry is the key feature of the technique. This investigation is specifically directed at the fabrication of an aluminum -4 weight percent magnesium alloy containing uniform dispersions of boron carbide. The boron carbide imparts a dual property to the composite. It has high hardness and the ability to absorb neutrons.

30991 **(SAND—81-8212) Stiffness and strength of SiC-Al composites.** Skibo, M.D. (Sandia National Labs., Livermore, CA (USA)). Jun 1981. Contract AC04-76DP00789. 24p. NTIS, PC A02/MF A01. Order Number DE81028684.

This paper reports the results of a study in which the strength and stiffness of a silicon carbide-2024 Al composite system were determined as a funtion of whisker volume fraction and aspect ratio. The hot pressed composites contained from 0 to 26 volume percent SiC, and the average aspect ratio was varied by adjusting the whisker to particulate ratio prior to composite fabrication. By heat treating the 2024 Al matrix to various strength levels, the effects of matrix properties on composite strength was also evaluated. The experimental results generated in this study were correlated with theoretical composite models.

30992 **Lanthanum-hexaboride carbon composition for use in corrosive hydrogen-fluorine environments.** Holcombe, C.E.; Kovach, L.; Taylor, A.J. (to Dept. of Energy). US Patent 4,261,753. 14 Apr 1981. Filed date 22 Jan 1980. vp.

The present invention relates to a structural composition useful in corrosive hydrogen-fluorine environments at temperatures in excess of 1400° K. The composition is formed of a isostatically pressed and sintered or a hot-pressed mixture of lanthanum hexaboride particles and about 10-30 vol. % carbon. The lanthanum - hexaboride reacts with the high-temperature fluorine-containing bases to form an adherent layer of corrosion-inhibiting lanthanum trifluoride on exposed surfaces of the composition. The carbon in the composite significantly strengthens the composite, enhances thermal shock resistance, and significantly facilitates the machining of the composition.

30993 **Method of making metal-doped organic foam products.** Rinde, J.A. (to Dept. of Energy). US Patent 4,261,937. 14 Apr 1981. Filed date 3 Apr 1979. vp.

Organic foams having a low density and very small cell size and method for producing same in either a metal-loaded or unloaded (Nonmetal loaded) form are described. Metal-doped foams are produced by soaking a polymer gel in an aqueous solution of desired metal salt, soaking the gel successively in a solvent series of decreasing polarity to remove water from the gel and replace it with a solvent of lower polarity with each successive solvent in the series being miscible with the solvents on each side and being saturated with the desired metal salt, and removing the last of the solvents from the gel to produce the desired metal-doped foam having desired density cell size, and metal loading. The unloaded or metal-doped foams can be utilized in a variety of applications requiring low density, small cell size foam. For example, rubidium-doped foam made in accordance with the invention has utility in special applications, such as in x-ray lasers.

3604 Polymers And Plastics

30994 **(SAND—81-0974) DYTHERM: a new temperature-resistant removable foam encapsulant.** Wischmann, K.B. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01. Order Number DE81028184.

A new commercially available copolymer produced by ARCO/Polymers, Inc., under the tradename of DYTHERM X214 has been evaluated for use as a removable foam encapsulant. DYTHERM X214 is a styrene-maleic anhydride copolymer that increases the upper use temperature of previously employed polystyrene bead foam from 80°C to about 115°C. The processing of DYTHERM X214 is similar to polystyrene foam beads except that higher fusion temperatures (~ 125°C) are necessary and polar solvents (e.g., tetrahydrofuran) are needed for foam removal. Mechanical properties (e.g., compressive strength) of DYTHERM X214 are slightly higher than polystyrene foam beads at comparable densities; there is little difference in other physical properties.

30995 (SERI/CP—633-1145, pp 77-81) **Polymer development and performance evaluation at JPL.** Adams, M.A.; Cleland, E.L. (Jet Propulsion Lab., Pasadena, CA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

In fiscal year 1981, studies are being performed in areas including (1) the experimental study of polymer photoprocesses and mechanical behavior; (2) the generation of preliminary criteria for the establishment and growth of a polymer materials data base for low-cost enclosure applications; and (3) an assessment of polymeric materials for heliostat/dome applications.

30996 (SERI/CP—633-1145, pp 83-86) **Reactivity of polymers with mirror materials.** Brauman, S.K.; MacBlane, D.B.; Mayo, F.R. (SRI International, Menlo Park, CA). Apr 1981. NTIS, PC A08/MF A01.

In Solar thermal energy systems research and advanced development program review.

The objective of this program is to establish the stability of polymeric materials that are under consideration as transmitting superstrates/substrates for solar mirror materials. Candidate polymeric materials are being evaluated for the coating of silver and aluminum mirrors without a deleterious reaction occurring between the mirror surface and the coating. Results are summarized from screening studies designed to evaluate the interface stabilities of different polymer/mirror combinations. The objective of this initial screening is the selection of promising polymer/mirror combinations for subsequent long-term, semi-quantitative environmental evaluation.

30997 **(LA-tr—81-15) Production of copolymer of ketene and formaldehyde with ionospheric radioactive ray.** Okamura, S.; Hayashi, K.; Fujiwara, K. (Los Alamos National Lab., NM (USA)). Jul 1981. Translation of . Japanese Patent 1963-41,17674. 5p. NTIS, PC A02/MF A01. Order Number DE81027619.

A method for producing a copolymer of ketene and formaldehyde by using radiation is described. This method is different from present methods in that it creates a new type of polymers completely different from monopolymers of ketene or polyoxymethylene by actively having a large amount of ketene polymerized with formaldehyde.

30998 **Chain distribution functions and segment density functions of polymer chains confined by absorbing or reflecting barriers.** Gaylord, R.J.; Paisner, M.J.; Lohse, D.J. (Univ. of Illinois, Urbana). Contract EY-76-C-02-1198. *Journal of Macromolecular Science, Part B: Physics ;* **17**: No. 3, 473-499(1980).

Exact infinite series expressions and simple analytical approximations are derived for the chain distribution functions and the segment density functions of cilia, loops, bridges, and floating chains confined between a pair of infinite parallel walls which act as reflecting or absorbing barriers.

30999 **Computer simulation of chains in solution and bulk state.** Frisch, H.L. (State Univ. of New York, Albany); Bishop, M.; Ceperley, D.; Kalos, M.H. Contract EY-76-C-02-3077-000;W-7405-ENG-48. *Journal of Macromolecular Science, Part B: Physics ;* **18**: No. 3, 453-459(1980).

The results of preliminary tests of Monte Carlo and molecular dynamics simulations of static and dynamic properties of a simplified continuum model of polymer chain systems in solution and in bulk melts in the context of other studies in this field are described. In particular, reptation Monte Carlo studies of these continuum multichain systems at reduced chain densities of 0.3 and 0.5 for chains of up to 70 segments give the same exponent for the segment dependence as found by De Vos and Bellemans for chains on lattices.

3606 Other Materials

REFER ALSO TO CITATION(S) 30028, 30028, 30068, 30548, 30625, 30627, 30930, 30941, 30988, 30989, 31082, 31135, 31425, 31429, 31430

31000 **(DOE/ER/01198—135) Defect studies of molecular and rare-gas crystals down to 50 mK and up to 150 MPa.** Simmons, R.O. (Illinois Univ., Urbana (USA). Dept. of Physics). 1981. Contract AC02-76ER01198. 14p. (CONF-810386—1). NTIS, PC A02/MF A01. Order Number DE81026617.

From American Crystallographic Association meeting; College Station, TX, USA (Mar 1981).

Techniques have been developed to prepare single crystals of condensed gases of mm or larger size, to ascertain their degree of crystalline perfection and fix their orientation, to measure Bragg spacings, changes in Bragg spacings and intensities. For precise work at higher temperatures and pressures a Be specimen cell attached to a heat exchanger is used at the focus of a large orientable back-reflection camera. Phase transitions arising from changes in molecular rotational ordering in solid CH_4 and CD_4 and lattice parameters during sublimation and melting of solid Ar, Kr, and Xe have thus been studied. For lower temperatures, the x-ray scattering specimen cell is fixed to a helium dilution refrigerator; it can be taken down to 50 mK and internally pressurized to 20 MPa. The sealed-off x-ray source is orientable about three orthogonal axes. Scattered x-rays are collected in an orientable position-sensitive detector. Examples of investigations by coherent scattering include 1) determination of the symmetries of the different phases below 1 K of the system solid ortho- and para- H_2, and 2) microscopic study of isotopic phase separation in solid ^3He-^4He mixtures below 0.4 K. In case 1), the known fcc form of solid hydrogen, stable below about 2 K for ortho-rich material, was determined to transform to hcp form at lower concentrations and temperatures. The transformation temperatures and compositions could be followed, despite internal specimen heating due to spontaneous ortho- to paraconverision, below 200 mK. In case 2), x-ray studies of isotopic phase separation in ^3He-^4He bcc solids were carried out by B. A. Fraass. Direct determination of Bragg spacings of the daughter phases and their perfection and orientation with respect to the matrix could be made for the first time, and new characteristics of the phase separation phenomena discovered as specimens were cooled and reheated in a range below 400 mK.

31001 **Hydrogen elimination during the glow-discharge deposition of a-Si:H alloys.** Kampas, F.J.; Griffith, R. (Department of Energy and Environment, Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Applied Physics Letters ;* **39**: No. 5, 407-409(1 Sep 1981).

A model of the deposition of a-Si:H films by silane glow discharge is presented. Three steps are involved: SiH_2 addition, H_2 elimination, and cross linking. The model is based upon SiH_2 gas-phase chemistry and explains the dependence of hydrogen content of a-Si:H upon substrate temperature.

31002 **(LA-UR—81-1664) Observation of high field DHVA-effect and induced magnetism in single crystal $TiBe_2$.** van Deursen, A.P.J.; van Ruitenbeek, J.M.; Verhoef, W.A.; de Vroomen, A.R.; Smith, J.L.; de Groot, R.A.; Koelling, D.D.; Mueller, F.M. (New Mexico Univ., Albuquerque (USA). Dept. of Geology; Research Inst. for Materials, Nijmegen (Netherlands); Argonne National Lab., IL (USA)). 1981. Contract W-7405-ENG-36. 3p. (CONF-810809—12). NTIS, PC A02/MF A01. Order Number DE81025292.

From 16. international conference on low temperature physics; Los Angeles, CA, USA (19 Aug 1981).

Recently much interest has been given to itinerant magnetism in cubic Laves phase or C15 materials. Primarily this stems from the discussion of the relationship of p-state pairing and ferromagnetism in $ZrZn_2$ by Enz and Matthias, and the possibility of triplet superconductivity. The most recent work in this field has focused on the isoelectronic, isostructural material $TiBe_2$, and the possibility that this material is metamagnetic. That $TiBe_2$ is close to some form of magnetic instability can be infered indirectly from the peaked nature of its density of states near the fermi level, but also from the observation of ferromagnetism in TiBe/sub 2-x/Cu/sub x/ , when x is greater than about 0.15. In this paper a single crystal of pure $TiBe_2$ is considered in fields larger thafi 15 Tesla (T) and at a temperature of 1.3°K.

31003 **(PNL-SA—9101) Thermal phase stability of some simulated Defense waste glasses.** May, R.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1981. Contract AC06-76RL01830. 33p. (CONF-810528—11). NTIS, PC A03/MF A01. Order Number DE81028012.

From 83. symposium on nucleation and crystallization in glasses; Washington, DC, USA (3 May 1981).

Three simulated defense waste glass compositions developed by Savannah River Laboratories were studied to determine viscosity and compositional effects on the comparative thermal phase stabilities of these glasses. The glass compositions are similar except that the 411 glasses are high in lithium and low in sodium compared to the 211 glass, and the T glasses are high in iron and low in

aluminum compared to the C glass. Specimens of these glasses were heat treated using isothermal anneals as short as 10 min and up to 15 days over the temperature range of 450°C to 1100°C. Additionally, a specimen of each glass was cooled at a constant cooling rate of 7°C/hour from an 1100°C melt down to 500°C where it was removed from the furnace. The following were observed. The slow cooling rate of 7°C/hour is possible as a canister centerline cooling rate for large canisters. Accordingly, it is important to note that a short range diffusion mechanism like cooperative growth phenomena can result in extensive devitrification at lower temperatures and higher yields than a long-range diffusion mechanism can; and can do it without the growth of large crystals that can fracture the glass. Refractory oxides like CeO_2 and (Ni, Mn, Fe)$_3O_4$ form very rapidly at higher temperatures than silicates and significant yields can be obtained at sufficiently high temperatures that settling of these dense phases becomes a major microstructural feature during slow cooling of some glasses. These annealing studies further show that below 500°C there is but little devitrification occurring implying that glass canisters stored at 300°C may be kinetically stable despite not being thermodynamically so.

31004 **Effect of ion-beam sputter damage on Schottky barrier formation in silicon.** Fonash, S.J.; Ashok, S.; Singh, R. (Engineering Science Program, The Pennsylvania State University, University Park, Pennsylvania 16802). SG-0-9233-1. *Applied Physics Letters ;* **39**: No. 5, 423-425(1 Sep 1981).

Abnormal rectifying behavior has been observed in molybdenum/silicon Schottky barrier diodes produced by ion-beam sputter deposition of Mo on single-crystal Si. Rectifying, rather than ohmic contacts are obtained on p-type Si, while ohmic behavior is seen on n-type Si. These results are contrary to the usual results reported in the literature, and are shown to be caused by ion-beam surface damage of Si. The damage does not simply cause a surface layer of high-recombination velocity, but rather tends to bend the Si band edges downwards, irrespective of the Si conductivity type.

31005 **Heteroepitaxial silicon growth on polycrystalline $MoSi_2$.** Campisi, G.J.; Bevolo, A.J.; Shanks, H.R.; Schmidt, F.A. (Ames Laboratory, USDOE, Iowa State University, Ames, Iowa 50011). W-7405-ENG-82. *Journal of Applied Physics ;* **52**: No. 8, 5043-5049(Aug 1981).

Heteroepitaxial silicon was grown on polycrystalline $MoSi_2$ by electron beam evaporation at 800 °C in an ultrahigh vacuum. The silicon films with a thickness between 2 and 12 μm grew with either an (111) or (233) orientation. The growth and morphology of the silicon deposit was studied as a function of temperature and the partial pressure of oxygen. Depositions at substrate temperatures of 950 and 1100 °C exceeded the epitaxial temperatures producing films that had faceted grains measuring 2—8 μm in cross section along with larger grains measuring nearly 200 μm across. The introduction of 10^{-10} Torr partial pressure of oxygen during deposition at 1100 °C changed the morphology and eliminated the large grains. The presence of oxygen at 800 °C prevented epitaxial growth.

31006 **New features of the temperature dependence of photoconductivity in plasma-deposited hydrogenated amorphous silicon alloys.** Vanier, P.E.; Delahoy, A.E.; Griffith, R.W. (Department of Energy and Environment, Brookhaven National Laboratory, Upton, New York 11973). DE-AC01-76CH00016. *Journal of Applied Physics ;* **52**: No. 8, 5235-5242(Aug 1981).

The temperature and flux dependences of photoconductivity have been investigated for plasma-deposited hydrogenated amorphous silicon alloys produced under a variety of processing conditions. In undoped films, new features such as thermal quenching and supralinearity are observed. Such behavior is critically dependent on the position of the Fermi level, and is not observed in alloys doped by the addition to the plasma of PH_3, B_2H_6, O_2+N_2 mixtures, or air. Interpretation of the data is based on a model of competing recombination centers.

31007 **Determining the field emitter temperature during laser irradiation in the pulsed laser atom probe.** Kellogg, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE ACO4-76-DP00789. *Journal of Applied Physics ;* **52**: No. 8, 5320-5328(Aug 1981).

Three methods are discussed for determining the field emitter temperature during laser irradiation in the recently developed Pulsed Laser Atom Probe. A procedure based on the reduction of the lattice evaporation field with increasing emitter temperature is found to be the most convenient and reliable method between 60 and 500 K. Calibration curves (plots of the evaporation field versus temperature) are presented for dc and pulsed field evaporation of W, Mo, and Rh. These results show directly the important influence of the evaporation rate on the temperature dependence of the evaporation field. The possibility of a temperature calibration based on the ionic charge state distribution of field evaporated lattice atoms is also discussed. The shift in the charge state distributions which occurs when the emitter temperature is increased and the applied field strength is decreased at a constant rate of evaporation is shown to be due to the changing field and not the changing temperature. Nevertheless, the emitter temperature can be deduced from the charge state distribution for a specified evaporation rate. Charge state distributions as a function of field strength and temperature are presented for the same three materials. Finally, a preliminary experiment is reported which shows that the emitter temperature can be determined from field ion microscope observations of single atom surface diffusion over low index crystal planes. This last calibration procedure is shown to be very useful at higher temperatures (>600 K) where the other two methods become unreliable.

31008 **Small-angle x-ray and electron scattering from (SN)/sub x/.** Schultz, J.M.; Bentley, J.; Hendricks, R.W.; Lin, J.S.; Petermann, J. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). 40 637-77. *Journal of Applied Physics ;* **52**: No. 8, 5389-5391(Aug 1981).

Small-angle x-ray and electron scattering from (SN)/sub x/ crystals is reported. Analysis of the scattering curves yields identification of rodlike scatterers with diameters of 50—100 nm and a density different from that of the matrix (SN)/sub x/. No scattering from microscopically observed fibrillar entities with diameters less than 10 nm was detected, indicating that these features bear approximately the same density as the matrix.

31009 **Neutron-irradiated crystalline quartz.** Anderson, A.C.; McMillan, J.A.; Walker, F.J. (Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). DE-AC02-76ER01198. *Physical Review [Section] B: Condensed Matter ;* **24**: No. 2, 1120-1121(15 Jul 1981).

Neutron irradiation of crystalline SiO_2 creates two-level-state (TLS) excitations similar to those found in vitreous SiO_2. Using evidence obtained from x-ray and mass-density measurements, we conclude that the TLS excitations in damaged crystals need not reside in regions of material made amorphous.

31010 **Crystal perfection of HgI_2 studied by neutron and gamma-ray diffraction.** Yelon, W.B.; Alkire, R.W.; Schieber, M.M.; van den Berg, L.; Rasmussen, S.E.; Christensen, H.; Schneider, J.R. (University of Miissouri Research Reactor, and Department of Physics, University of Missouri-Columbia, Columbia, Missouri 65211). DE-AC08-71INVO1183. *Journal of Applied Physics ;* **52**: No. 7, 4604-4609(Jul 1981).

The crystalline perfection of wire sawn pieces of vapor grown single crystals of mercuric iodide was compared with the perfection of (00l) cleaved sections of the same crystal from which nuclear radiation detectors have been fabricated. The crystalline perfection was studied using neutron and gamma-ray diffraction rocking curves. Most of the gamma-ray data were obtained using a high intensity source of ^{153}Sm gamma rays with a wavelength of $\lambda = 0.12$ A. Some of the data were obtained using highly penetrating ^{198}Au gamma rays with a shorter wavelength of $\lambda = 0.03$ A. The neutrons had a wavelength of $\lambda = 1.07$ A. It was found that, in terms of the mosaic spread of the crystals, the cleaved detector plates have a much lower crystalline perfection than the thicker un-

cleaved detector plates. At the same time, the results show that for detectors cut from the same crystal, the one with the lower spectral resolution for radiation detection will also have a lower perfection and larger width of the gamma-ray rocking curve. These results suggest consideration should be given to alternative fabrication procedures for HgI_2 nuclear radiation detectors.

31011 Investigation of high-temperature annealing and quenching effects on Al-nSi diodes by C-V and I-V measurements. Wu, C.M.; Yang, E.S. (Department of Electrical Engineering, Columbia University, New York, New York 10027). XZ-0-9226. *Journal of Applied Physics ;* **52**: No. 7, 4700-4703(Jul 1981).

The behavior of Al-nSi diodes heat treatment above the eutectic temperature (600 °C) is studied by varying the annealing time and cooling rate. We have used the capacitance-voltage characteristic as a measure of the influence of the doping density and thickness of the recrystallized silicon layer at the interface. Poisson's equation is solved to obtain the C-V characteristic and to relate it to the effective barrier height. We find that the barrier height is independent of the annealing time, but it is a function of the cooling rate. It appears that the diffusion of aluminum into silicon does not play a significant role, but fast quenching tends to prevent aluminum from precipitation, so that the recrystallized silicon layer is highly doped.

31012 Ultraviolet photoelectron spectroscopy study of the adsorption of oxygen on reduced $SrTiO_3$ surfaces. Ferrer, S.; Somorjai, G.S. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). W-7405-ENG-48. *Journal of Applied Physics ;* **52**: No. 7, 4792-4794(Jul 1981).

The adsorption of oxygen on a reduced $SrTiO_3$ (111) surface occurs in two distinct phases. At low exposures (less than 1 L), the adsorption leads to the incorporation of O= ions into the vacant lattice oxygen sites. At higher exposures a second different oxygen species adsorbs.

31013 Reply to "Comment on 'Cathodoluminescence studies of anomalous ion implantation defect introduction in ZnTe' ". Norris, C.B. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Journal of Applied Physics ;* **52**: No. 7, 4861-4862(Jul 1981).

In the light of very recent data, our previous study gives strong evidence that the dominant postrange defects in ion-implanted ZnTe are not zinc interstitials (Zn/sub i/). The prior Grenoble work is discussed with respect to current knowledge concerning shallow acceptors in ZnTe and the insensitivity of radiotracer measurements to vacancy introduction. It is concluded that the Grenoble results do not conflict with ours in that they provide no direct evidence that Zn/sub i/ dominate the postrange damage in ZnTe.

31014 Total and net displacement functions for monatomic materials. Coulter, C.A. (Alabama Univ., University (USA). Dept. of Physics); Parkin, D.M. (Los Alamos Scientific Lab., NM (USA)). *Journal of Nuclear Materials ;* **95**: No. 1/2, 193-200(Nov 1980).

Using the atomic scattering cross section and electronic stopping power formulas of Lindhard et al. we have numerically calculated the total and net displacement functions characterizing displacement cascades in amorphous monatomic materials. The dependence of these functions on energy, type of material, displacement threshold, capture threshold, and binding energy is exhibited and discussed. Analytical approximations are given for most of the numerical results.

31015 Glass leaching studies by sputter-induced photon spectrometry (SIPS). Tsong, I.S.T. (Pennsylvania State Univ., University Park); Houser, C.A.; White, W.B.; Power, G.L.; Tong, S.S.C. Contract EY-76-S-02-2754. *Journal of Non-Crystalline Solids ;* **38 & 39**: 649-654(1980).

The effect of composition on the leaching behavior of soda-lime silicate glasses is studied by depth-profiling using the sputter-induced photon spectrometry (SIPS) technique on hydrated glasses of variable Na_2O and CaO contents. In addition, the increase in the thickness of the leached layers as a function of hydration time for the $18Na_2O$ 12CaO $70SiO_2$ glass is also determined. The results indicate that a mechanism of interdiffusion is in operation and the diffusion coefficients for hydrogen and sodium are calculated using the Doremus model of interdiffusing ions.

40 CHEMISTRY

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 29808, 29875, 29969, 29970, 29973, 29974, 29975, 29977, 29979, 29979, 29980, 29981, 29982, 29993, 29994, 29995, 29996, 29997, 29998, 29999, 30000, 30005, 30006, 30007, 30008, 30009, 30010, 30011, 30012, 30013, 30014, 30015, 30016, 30017, 30058, 30059, 30411, 30500, 31191, 31191, 31195

31016 (CONF-810740—1) Background fitting for electron energy-loss spectra. Bentley, J.; Lehman, G.L.; Sklad, P.S. (Oak Ridge National Lab., TN (USA); Oak Ridge Associated Universities, Inc., TN (USA)). 1981. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01. Order Number DE81027117.

From 3. analytical electron microscopy workshop; Vail, CO, USA (13 Jul 1981).

Microanalysis using electron energy loss spectroscopy is now well established. In order to assess true edge profiles and obtain integrated intensities of the inner shell ionization edges of interest, it is first necessary to subtract the background. Usually a simple inverse power law is used, but for some spectra this form does not fit well. An alternative form which results in superior fits is described.

31017 (CONF-8007111—1) Concentration of organic compounds in water. A literature survey. Jolley, R.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 23p. NTIS, PC A02/MF A01. Order Number DE81026517.

From Workshop on protocol development: criteria and standards for potable reuse and feasible alternatives; Warrenton, VA, USA (29 Jul 1980).

Because of the large variety of chemical compounds present either naturally or as industrial contaminants in water samples, no single concentration method currently available is adequate for concentrating all organics in the water sample. Consequently, in an attempt to concentrate or isolate as much of the organic matter as possible, most researchers have combined several methods that may become quite complex and technically difficult to achieve. The author discusses, then summarizes most of the current practical methods in a table and presents the utility of each method along with major advantages and disadvantages. Selection of concentration method must be based on the biological test to be conducted. In addition, the concentration method must be chosen on the basis of the chemical and physical properties of the organic constituents to be tested. It is recommended that methods to evaluate and compare different concentration techniques be developed and applied. This will require increased emphasis on chemical analysis to identify much of the organic material in the concentrates. Measurements of general parameters, such as total organic carbon, cannot be used to reliably compare concentration techniques. 91 references.

31018 (DOE/EV/10404—2) Reactivation of an amino bonded phase liquid chromatographic column. Karlesky, D.; Shelly, D.C.; Warner, I. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). 1980. Contract AS05-80EV10404. 13p. NTIS, PC A02/MF A01. Order Number DE81028459.

The versatility of n-propyl amine bonded phase columns is evidenced by the fact that separations can be performed in the normal and reversed phase and ion-exchange modes. However the functional group of the bonded phase amine can undergo condensation reactions with carbonyls. This paper describes the reactivation of an n-propyl amine bonded phase column after deactivation with acetone. Using reversed phase aqueous conditions the condensation product (Schiff's base) can be hydrolyzed to original reactants. Column performance was evaluated before and after deactivation

and after reactivation to monitor the effectiveness of the reactivation procedure. Results showed that column performance after reactivation compared to column performance before deactivation within experimental error.

31019 **(DOE/EV/10404—6) Investigation of separation mechanisms in the normal and reversed phase chromatography of polynuclear aromatic hydrocarbons on an amino bonded phase column.** Karlesky, D.; Shelly, D.C.; Warner, I. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). 1980. Contract AS05-80EV10404. 27p. NTIS, PC A03/MF A01. Order Number DE81028461.

Experiments were run using an n-propyl amine polar bonded phase (Chromosorb LC-9) liquid chromatographic column in both the normal and reversed phase mode. Results indicate that the mechanism of separation in the normal phase is due mainly to a charge transfer interaction between the lone pair electrons on the stationary phase nitrogen and the π electron cloud of the solute PNAs. Elution order seems to depend upon a combination of π energy, electron affinity, and type of ring condensation of the solute. Comparing plots of log I versus number of aromatic carbons for catacondensed PNAs suggest that while the specific interaction is different than that seen in silica chromatography, the overall adsorption effect is comparable. In the reversed phase the separation mechanism is either a pure partitioning effect in highly polar mobile phases (methanol/water), or a mixture of liquid-solid adsorption and liquid-liquid partition in less polar solvent systems (acetonitrile/water).

31020 **(DOE/EV/10404—T2) High-performance liquid chromatography/video fluorometry. Part I. Instrumentation.** Fogarty, M.P.; Shelly, D.C.; Warner, I.M. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). 1981. Contract AS05-80EV10404. 31p. NTIS, PC A02/MF A01. Order Number DE81028428.

A rapid scanning, two-dimensional fluorometer has been used to obtain Emission-Excitation Matrices (EEMs) of the effluent of an HPLC. These spectra, obtained on the fly, provide qualitative as well as quantitative information about unknown samples. An in-depth discussion of the instrumentation developed as well as data processing alternatives is presented.

31021 **(DOE/EV/10404—T3) High-performance liquid chromatography/video fluorometry. Part II. Applications.** Shelly, D.C.; Fogarty, M.P.; Warner, I.M. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). 1981. Contract AS05-80EV10404. 35p. NTIS, PC A03/MF A01. Order Number DE81028458.

A Video Fluorometer is used as a detector for HPLC to characterize highly complex samples. Data selection and evaluation techniques are discussed so as to speed the spectral identification process. Several well-known Polynuclear Aromatic Hydrocarbons are found in the samples.

31022 **(DOE/EV/10404—T4) Recent advances in multicomponent fluorescence analysis.** Warner, I.M.; McGown, L.B. (Texas A and M Univ., College Station (USA). Dept. of Chemistry; California State Univ., Long Beach (USA). Dept. of Chemistry). 1980. Contract AS05-80EV10404. 190p. NTIS, PC A09/MF A01. Order Number DE81028337.

In this manuscript, the authors have presented examples of the recent advances in multicomponent fluorescence analysis. This review is limited in scope to developments in instrumental methods although there is a brief review of multicomponent data reduction.

31023 **(DOE/EV/10405—4) Proton-induced x-ray emission analysis: a complement to analytical methods used in environmental studies.** Mangelson, N.F.; Eatough, D.J.; Eatough, N.L.; Hansen, L.D.; Hill, M.W.; Lee, M.L.; Phillips, L.R.; Post, M.E.; Richter, B.E.; Ryder, J.F. (Brigham Young Univ., Provo, UT (USA)). 1980. Contract AC02-80EV10405. 5p. (CONF-801111—50). NTIS, PC A02/MF A01. Order Number DE81029012.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

Particle induced x-ray emission (PIXE) analysis is a highly versatile method of element analysis. Thus it is well suited for use as a complement to other methods of analysis in experimental programs requiring both chemical and elemental analyses. This paper reports some results of two projects where PIXE was used in conjunction with titration calorimetry, ion chromatography, atomic absorption spectroscopy, gas chromatography/mass spectrometry, x-ray fluorescence spectroscopy and some other methods. The first is a study of sulfur chemistry in a copper smelter plume. Arsenic was found to be a conservative tracer of the plume and was used for calculation of plume dilution. Calcium was found to be characteristic of the background or ambient aerosol and was used to correct particulate data for the background contribution. The use of both plume and ambient tracers and of data from other analytical methods noted above led to the determination of several aspects of the plume sulfur chemistry. The second project is a study of the effluents from a high-temperature, high-pressure entrained flow gasifier. The scrubber water and particulate matter entrained in the scrubber water and in the product gas were analyzed by PIXE. Of particular interest were the low elemental concentrations in the scrubber water.

31024 (GJBX—212-81, pp 135U-139U) **Mechanisms of chelation of heavy metals by chitosan.** Averbach, B.L. (Massachusetts Inst. of Tech., Cambridge). Dec 1980. NTIS, PC A14/MF A01.

From Topical meeting: the recovery of uranium from sea water; Cambridge, MA, USA (1 Dec 1980).

The concentration profiles of several heavy metal ions and anions have been measured in chitosan membranes immersed in dilute aqueous solutions. The shapes of the concentration curves for the metal ions is characteristic of a diffusion process in which the diffusion coefficient is a function of the concentration. The anion penetrates much more rapidly than the cation, however, and the concentration appears to be dependent on the reaction kinetics. We propose a mechanism whereby the metal ion bonds with the nitrogen in the functional amino group, with the bridging oxygen and with two hydroxyl groups in a neighboring glucose ring. The anion, on the other hand, bonds ionically to the metal-amino complex in order to neutralize the charge and to the protonated amino sites which have not reacted with the metal ion. In the case of uranium in sea water, it is probable that the uranium is present as a uranyl complex and that bonding with chitosan will occur by ionic bonding, that is, salt formation, rather than by covalent bonding to the amino groups. Uranyl complexes in dilute concentration will thus compete with chloride and the relative concentrations will be determined by the equilibrium constants. Work on the reaction between chitosan and dilute solutions of copper sulfate is reported. A mechanism for these reactions is postulated, and it is suggested that the same mechanism carries over to uranium in sea water. This suggests certain limitations on the process which should be explored if chitosan is to be used for this purpose.

31025 **(IS—4774) Extended work plan for the simultaneous assay of uranium and plutonium, and their isotopes, by optical emission spectroscopy.** Edelson, M.C.; Fassel, V.A. (Ames Lab., IA (USA)). Aug 1981. Contract W-7405-ENG-82. 68p. NTIS, PC A04/MF A01. Order Number DE81028364.

A summary of the results of an on-going study of the application of inductively coupled plasma-atomic emission spectroscopy (ICP-AES) to the simultaneous assay of uranium and plutonium, and their isotopes, is presented in this report. Projected experiments in the FY1982-FY1985 period are discussed.

31026 **(ORNL/TM—7805) Separations Science Data Base: an abstractor's manual.** Roddy, J.W.; McDowell, W.J.; Michelson, D.C. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01. Order Number DE81029101.

The Separations Science Data Base, designed specifically for the retrieval of information needed in chemical separations problems (i.e., how to perform a given separation under given conditions), is described. The procedure for entering records into the data base is given. The initial entries are concerned primarily with liquid-liquid extraction and liquid-solid ion exchange methods for

metal ions and salts; however, the data base is constructed so that almost any separations process can be accommodated. Each record is indexed with information provided under the following fields: author; title; publication source; date of publication; organization performing and/or sponsoring the work; brief abstract of the work; abstract number if the work has been so referenced, and/or abstractor's initials; type of separation system used (e.g., flotation); specific or generic name of the separation agent used (e.g., acetylacetone); list of substances separated (e.g., gold, copper); qualitative description of the supporting medium or matrix containing the substances before separation (e.g., nitrate); type of literature where the article was printed (e.g., book); and type of information that the article contains. Each of these fields may be searched independently of the others (or in combination), and the last six fields contain specific key words that are listed on the input form. Definitions are provided for the 39 information terms.

31027 **(PNL—3832) Materials characterization center workshop on compositional and microstructural analysis of nuclear waste materials. Summary report.** Daniel, J.L.; Strachan, D.M.; Shade, J.W.; Thomas, M.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 87p. NTIS, PC A05/MF A01. Order Number DE81027029.

The purpose of the Workshop on Compositional and Microstructural Analysis of Nuclear Waste Materials, conducted November 11 and 12, 1980, was to critically examine and evaluate the various methods currently used to study non-radioactive, simulated, nuclear waste-form performance. Workshop participants recognized that most of the Materials Characterization Center (MCC) test data for inclusion in the Nuclear Waste Materials Handbook will result from application of appropriate analytical procedures to waste-package materials or to the products of performance tests. Therefore, the analytical methods must be reliable and of known accuracy and precision, and results must be directly comparable with those from other laboratories and from other nuclear waste materials. The 41 participants representing 18 laboratories in the United States and Canada were organized into three working groups: Analysis of Liquids and Solutions, Quantitative Analysis of Solids, and Phase and Microstructure Analysis. Each group identified the analytical methods favored by their respective laboratories, discussed areas needing attention, listed standards and reference materials currently used, and recommended means of verifying interlaboratory comparability of data. The major conclusions from this workshop are presented.

31028 **(UCRL—86169) Procedures for multielement analysis using high-flux fast-neutron activation.** Williams, R.E.; Hopke, P.K.; Meyer, R.A. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 15p. (CONF-8106130—1). NTIS, PC A02/MF A01. Order Number DE81026595.

From International conference on modern trends in activation analysis; Toronto, Canada (14 Jun 1981).

Improvements have been made in the rabbit system used for multi-element fast-neutron activation analysis at the Lawrence Livermore National Laboratory Rotating Target Neutron Source, RTNS-I. Procedures have been developed for the analysis of 20 to 25 elements in samples with an inorganic matrix and 10 to 15 elements in biological samples, without the need for prohibitively expensive, long irradiations. Results are presented for the analysis of fly ash, orchard leaves, and bovine liver.

31029 **Method and composition for testing for the presence of an alkali metal.** Guon, J. (to Department of Energy). US Patent 4,244,693. 13 Jan 1981. Filed date 28 Feb 1977. vp.

PAT-APPL-772627.

A method and composition for detecting the presence of an alkali metal on the surface of a body such as a metal plate, tank, pipe or the like is provided. The method comprises contacting the surface with a thin film of a liquid composition comprising a light-colored pigment, an acid-base indicator, and a nonionic wetting agent dispersed in a liquid carrier comprising a minor amount of water and a major amount of an organic solvent selected from the group consisting of the lower aliphatic alcohols, ketones and ethers. Any alkali metal present on the surface in elemental form or as an alkali metal hydroxide or alkali metal carbonate will react with the acid-base indicator to produce a contrasting color change in the thin film, which is readily discernible by visual observation or automatic techniques.

31030 **Apparatus for use in rapid and accurate controlled-potential coulometric analysis.** Frazzini, T.L.; Holland, M.K.; Pietri, C.E.; Weiss, J.R. (to Department of Energy). US Patent 4,244,800. 13 Jan 1981. Filed date 23 Aug 1979. vp.

PAT-APPL-069152.

An apparatus for controlled-potential coulometric analysis of a solution includes a cell to contain the solution to be analyzed and a plurality of electrodes to contact the solution in the cell. Means are provided to stir the solution and to control the atmosphere above it. A potentiostat connected to the electrodes controls potential differences among the electrodes. An electronic circuit connected to the potentiostat provides analog-to-digital conversion and displays a precise count of charge transfer during a desired chemical process. This count provides a measure of the amount of an unknown substance in the solution.

31031 **Preparative separation of lanthanoids by high-pressure liquid chromatography (HPLC).** Weuster, W.; Specker, H. (Lehrstuhl Anorganische Chemie I der Universitat, Bochum, Germany). *Angewandte Chemie, International Edition in English ;* **20**: No. 1, 132-133(Jan 1981).

The isolation of individual lanthanides by HPLC on the mg scale was attempted. Sm and Tb were separated cleanly, while Gd and Eu overlap. The method was applied to a monazite sand. Columns having a capacity of 5 mg were used; larger columns may allow separations on the g scale. 2 figures. (DLC)

31032 **Resin bead as a thermal ion source. A SIMS study.** Smith, D.H.; Christie, W.H.; Eby, R.E. (Oak Ridge National Lab., TN (USA). Analytical Chemistry Div.). *Journal of Mass Spectrometry and Ion Physics ;* **36**: No. 3, 301-316(Dec 1980).

Secondary ion mass spectrometry has been used to follow the course of typical thermal emission mass spectrometric analyses of U samples loaded on single anion resin beads. It was found that U stayed almost entirely in the carbon matrix remaining after the resin beads were heated, while C showed considerable mobility. An interpretation of the enhanced ionization efficiency observed from samples mounted in this fashion is presented.

31033 **Influence of specimen thickness in quantitative electron energy loss spectroscopy.** Zaluzec, N.J. (Argonne National Lab., IL). pp 112-113 of 38th annual proceedings of the Electron Microscopy Society of America. Bailey, G.W. (ed.). Ithaca, NY; Electron Microscopy Society of America (1980).

From 38. annual proceedings of the Electron Microscopy Society of America; San Francisco, CA, USA (1980).

It is proposed that the derivation of the relative intensity ratio measurements of any two characteristic electron energy loss spectroscopy (EELS) edges in a homogeneous compound is a measure of the specimen thickness limitations. Measurements were made on three homogeneous compounds, BN, Al_2O_3, and NiAl in order to test the thickness limitations. A plot of the experimental ratio of the intensity of the two edges vs the ratio of I/sub p//I/sub o/ where I/sub p/ is the integrated intensity of the plasmon loss electrons and I/sub o/ is the unscattered intensity indicates that when the relative specimen thickness (I/sub p//I/sub o/) exceeds ~ 0.2, the equations for calculating the number of atoms/cm^2 of an element detected by EELS experiments yield results which are suspect. The relative specimen thickness measurement is seen as an important parameter in quantitative EELS rather than the absolute specimen thickness. (BLM)

31034 **(HEDL—6798) Quantitative spark-source analysis of UO_2-PuO_2 for rare earths and tantalum, tungsten.** Alkire, G.J. (Hanford Engineering Development Lab., Richland, WA (USA)). [nd]. Contract AC14-76FF02170. 6p. NTIS, PC A02/MF A01. Order Number DE81026498.

A quantitative analytical technique good to 20% for the determination of Sm, Eu, Gd, Dy, Ta, and W in Pu-U mixed oxides

by spark source mass spectrography has been developed. The technique uses La as an added internal standard and an electronic integrator to measure peak areas of each line photometered on the densitometer. 3 tables.

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 29941, 30105, 30971, 30983, 30987, 31342

31035 **Production of high temperatures in the chemical laboratory: examples of application in lanthanoid oxo-chemistry.** Mueller-Buschbaum, H. (Institut fuer Anorganische Chemie der Universitat, Kiel, Germany). *Angewandte Chemie, International Edition in English ;* **20**: No. 1, 22-33(Jan 1981).

High-temperature reactions have always been a fascinating although difficult field of experimentation for the chemist. In the case of solid-state reactions the problems with apparatus increase exponentially with rising temperature, so that especially in this area of inorganic chemistry the modern techniques of producing high temperatures--from the solar furnace to the high-power CO_2 laser--have yielded new and interesting possibilities, particularly in the field of metastable high-temperature compounds. 15 figures.

31036 **(ORNL/TM—7942) Kinetic model for predicting the concentrations of active halogens species in chlorinated saline cooling waters. Final report.** Haag, W.R.; Lietzke, M.H. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 144p. NTIS, PC A07/MF A01. Order Number DE81028036.

A kinetic model has been developed for describing the speciation of chlorine-produced oxidants in seawater as a function of time. The model is applicable under a broad variety of conditions, including all pH range, salinities, temperatures, ammonia concentrations, organic amine concentrations, and chlorine doses likely to be encountered during power plant cooling water chlorination. However, the effects of sunlight are not considered. The model can also be applied to freshwater and recirculating water systems with cooling towers. The results of the model agree with expectation, however, complete verification is not feasible at the present because analytical methods for some of the predicted species are lacking.

31037 **(PB—81-852535) Krypton. January 1970-October 1980 (citations from the NTIS data base). Report for January 1970-October 1980.** Van Put, W. (New England Research Application Center, Storrs, CT (USA)). Oct 1980. 231p. NTIS PC N01/MF N01.

The cited reports from Federally funded research cover studies and applications of krypton. Storage facilities for krypton, and cryogenic or molecular sieves for its separation, as well as laser usage and rapid sampling, are also discussed. (Contains 200 citations.)

31038 **(PB—81-852543) Krypton. January 1976-October 1980 (citations from the Energy Data Base). Report for January 1976-October 1980.** Van Put, W. (New England Research Application Center, Storrs, CT (USA)). Oct 1980. 220p. NTIS PC N01/MF N01.

Studies and applications of krypton are covered in the cited reports. Storage facilities for krypton, and cryogenic or molecular sieves for its separation, as well as laser usage and rapid sampling, are also discussed. (Contains 200 citations.)

31039 **(PB—81-852550) Krypton. January 1970-October 1980 (citations from the Engineering Index data base). Report for January 1970-October 1980.** Van Put, W. (New England Research Application Center, Storrs, CT (USA)). Oct 1980. 182p. NTIS PC N01/MF N01.

Studies and applications of krypton are covered in the cited reports. Storage facilities for krypton, and cryogenic or molecular sieves for its separation, as well as laser usage and rapid sampling, are also discussed. (Contains 186 citations.)

31040 **(PB—81-852568) Krypton. January 1972-October 1980 (citations from the International Aerospace Abstracts data base). Report for January 1972-October 1980.** Van Put, W. (New England Research Application Center, Storrs, CT (USA)). Oct 1980. 148p. NTIS PC N01/MF N01.

Studies and applications of krypton are covered in the cited reports. Storage facilities for krypton, and cryogenic or molecular sieves for its separation, as well as laser usage and rapid sampling, are also discussed. (Contains 200 citations.)

31041 **Effect of temperature and counterion on the micelle formation process studied by positron annihilation techniques.** Djermouni, B.; Ache, H.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). *Journal of Physical Chemistry ;* **83**: No. 19, 2476-2479(1979).

The positron annihilation technique was applied to the study of the micelle formation process in micellar systems Aerosol OT and dodecylammonium propionate (DAP) in apolar solvents, such as benzene and isooctane. At certain surfactant concentrations abrupt changes in the number of thermal o-Ps atoms formed can be observed. The surfactant concentration at which this effect can be seen is widely temperature independent in Aerosol OT solutions while a significant shift to higher surfactant concentrations can be found with increasing temperature in DAP solutions. The effect of the nature of the counterion on the mechanism of micelle formation is further investigated by substituting the counterion Na^+ in Aerosol OT by tetraalkylammonium ions, N^+H_4, $N^+(CH_3)_4$, and $N^+(C_2H_5)_4$. The results are discussed in terms of the pseudophase model and multiple equilibrium model for micelle formation.

31042 **(UCRL—86489) Role of molecular dynamics on descriptions of shock-front processes.** Karo, A.M. (Lawrence Livermore National Lab., CA (USA)). 22 Jul 1981. Contract W-7405-ENG-48. 17p. (CONF-810684—45). NTIS, PC A02/MF A01. Order Number DE81028687.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

By means of a computational approach based on classical molecular dynamics, we can begin to form a realistic picture of shock-induced processes occurring at the shock front and resulting from the detailed, violent motion associated with shock motion on an atomic scale. Prototype studies of phase transitions will be discussed. We will also examine the interaction of the shock front with defects, surfaces, voids, and inclusions, and across grain boundaries. We will focus on the critical question of how mechanical energy imparted to a condensed material by shock loading is converted to the activation energy required to overcome some initial energy barrier in an initiation process.

31043 **Monoalkylchromium(III) complexes of a tetradentate N_4 macrocycle.** Samuels, G.J.; Espenson, J.H. (Iowa State Univ., Ames). *Inorganic Chemistry ;* **18**: No. 9, 2587-2592(1979).

Chromium(II) chloride in mixed aqueous solvents forms a strongly reducing complex with the macrocyclic ligand [15]aneN$_4$. Reactions of this complex with organic halides produce the monoalkyl complexes RCr([15]aneN$_4$)H$_2$O^{2+} which have been characterized and shown to have a trans configuration. The kinetics of these reactions have been studied, with the result that the reaction follows a second-order rate law. Rate constants have been evaluated for a range of organic halides. These results, together with the stoichiometry, the variation of rate with the constitution of RX, and related tests, suggest the following mechanism. The chromium(II) complex reacts with alkyl halides in two steps, rate-limiting halogen atom abstraction to generate a carbon-centered free radical followed by rapid coupling of the latter with a second chromium(II) complex.

31044 **Polarized electronic absorption spectra for dimolybdenum(II) tetraacetate.** Martin, D.S.; Newman, R.A.; Fanwick, P.E. (Iowa State Univ., Ames). *Inorganic Chemistry ;* **18**: No. 9, 2511-2520(1979).

Polarized spectra with rich vibrational detail are reported for two faces of single crystals of $Mo_2(O_2CCH_3)_4$ at temperatures down to 5 K. Evidence, which includes the orientation in space of transition moments for individual vibrational lines, hot bands, and

Franck-Condon factors, is presented that the 23,000-cm^{-1} band is the electric-dipole-allowed $^1A/sub\ 2u/$ reverse arrow $^1A/sub\ 1g/$ or δ^* reverse arrow δ with an origin at 21,700 cm^{-1}. However, the intensities are sufficiently low that lines excited vibronically, although somewhat weaker, approach the intensity of the dipole-allowed progression. A second transition at 26,500 cm^{-1} is evident as well from the low-temperature spectra. The spectra of a number of dimeric carboxylate complexes of molybdenum(II) are compared and the possible cause of the exceptionally low intensity for an electric-dipole-allowed transition is discussed.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 29768, 29943, 29944, 29945, 30071, 30099, 31043, 31153

31045 (DOE/ER/04060—T2) Energies of organic compounds. Technical progress report. Wiberg, K.B. (Yale Univ., New Haven, CT (USA). Dept. of Chemistry). 8 Jul 1981. Contract AS02-76ER04060. 6p. NTIS, PC A02/MF A01. Order Number DE81027878.

Experience with calorimeters is recounted. Enthalpies of combustion and hydrolysis were determined for cyclopropanes and ketals. Homogeneous catalysts were developed. No hard data are given. Some theoretical studies are reported briefly. (DLC)

31046 (DOE/EV/03018—T4) Rydberg states in azulene. Bouler, D.B. Jr. (Texas Univ., San Antonio (USA)). May 1981. Contract AS05-76EV03018. 71p. NTIS, PC A04/MF A01. Order Number DE81029135.

Thesis.

An analysis of the Rydberg states of azulene was made. This analysis involved comparison of various types of spectra. The assignment of the d-Rydbergs of azulene in the literature was confirmed, the p-Rydbergs were assigned, and evidence was presented for the intrusion of an s-Rydberg into the $S_0 \rightarrow S_2$ absorption region. The intrusion of the s-Rydberg into the $S_0 \rightarrow S_2$ absorption region was suggested as an explanation for the unique features of this spectral region in azulene.

31047 (DOE/SF/00115—T8) Synthesis of nitramines. Final report. Frankel, M.B.; Hill, M.E. (Stanford Research Inst., Menlo Park, CA (USA)). 11 Sep 1963. Contract AM03-76SF00115. 9p. NTIS, PC A02/MF A01. Order Number DE81026136.

Using known procedures, the following nitramines have been prepared: 20 g of 1,5-dinitro-3,7-endomethylene-1,3,5,7-tetrazacyclooctane; 5 g of 1-aceto-3,5,7-trinitro-1,3,5,7-tetrazacyclooctane; 9.5 g of 1,9-dinitroxy-2,4,6,8-tetranitrazanonane; 46 g of 1,9-diacetoxy-2,4,6,8-tetranitrazanonane; 7.3 g of 1,7-dinitroxy-2,4,6-trinitrazaheptane; and 42 g of 1,7-diacetoxy-2,4,6-trinitrazaheptane. The nitramines were purified to a constant melting point by repeated recrystallization. The purity and identity were confirmed by elemental analyses.

31048 Pressure dependence of the structure and properties of liquid n-butane. Jorgensen, W.L. (Purdue Univ., West Lafayette, IN). Contract W-7405-ENG-48. *Journal of the American Chemical Society ;* **103**: No. 16, 4721-4726(12 Aug 1981).

The effects of pressure on the structure, thermodynamic properties, and conformational equilibrium for liquid n-butane have been studied via statistical mechanics simulations at 1, 5000, and 15,000 atm. Consistent with Raman experiments on lower n-alkanes, increased pressure is found to increase the gauche populations in liquid n-butane; however, the shift amounts to only a 7% change in the population in going from 1 to 15,000 atm at -0.5°C. Various computed properties are found to be in very good agreement with experimental values including the density, heat of vaporization, and compressibility for which the discrepancies are 3, 4, and 10%, respectively, at 1 atm. The sharpening of the radial distribution functions reflects increased structure at higher pressure, though the effects are not striking in stereoplots even at 15,000 atm. Interestingly, the energy of liquid n-butane is computed to be lowest at 5000 atm which is in accord with Bridgman's observations in 1913 for a variety of organic liquids. Overall, a key finding is that the simple Lennard-Jones description of the intermolecular interactions remains successful over the pressure range studied which represents a compression of 33%. 9 figures.

31049 Solution and solid carbon-13 magnetic resonance study of the conformation of 9,10-dihydroanthracene and its 9,10-methylated derivatives. Dalling, D.K.; Zilm, K.W.; Grant, D.M.; Heeschen, W.A.; Horton, W.J.; Pugmire, R.J. (Univ. of Utah, Salt Lake City). Contract AC02-78ER05006. *Journal of the American Chemical Society ;* **103**: No. 16, 4817-4824(12 Aug 1981).

The ^{13}C NMR chemical shifts of the 9,10-methylated 9,10-dihydroanthracenes have been obtained, both in the traditional manner in solution and in the solid state by use of cross polarization and magic angle spinning techniques. In addition, the temperature dependence of the solution chemical shifts was measured from about -70 to 40°C. Chemical shift effects resulting from methyl substitution are discussed. A nonlinear-least-squares regression analysis was performed on the variable-temperature methyl shift for three of the compounds demonstrating unequally weighted conformational averaging, and the relevant thermodynamic and chemical shift parameters are presented. Both solid and solution spectra indicate ring flattening when geminal methyls are present. Furthermore, the methyls in the more sterically crowded molecules are in environments which differ substantially from those of the simpler molecules, indicating considerable variety in the conformational features.

31050 Mechanistic pathways in the catalysis of olefin hydrocarboxylation by rhodium, iridium, and cobalt complexes. Forster, D.; Hershmann, A.; Morris, D.E. (Monsanto Co., St. Louis, MO). *Catalysis Reviews - Science and Engineering ;* **23**: No. 1 & 2, 89-105(1981). (CONF-800779—).

From 1. Berkeley catalysis and surface science conference; Berkeley, CA, USA (16 Jul 1980).

Carboxylic acids can be synthesized by reacting olefins with carbon monoxide and water in the presence of a variety of transition metal catalysts. Mechanisms involved in hydrocarboxylation reactions are discussed in this paper. The following topics are covered: investigation of the route to metal-carbon bond formation during rhodium-catalyzed hydrocarboxylation of ethylene; investigations into the mechanism of the iridium-catalyzed hydrocarboxylation of olefins; synthesis of reaction intermediates; reactions of the catalytically significant iridium complexes; catalytic cycle; and the cobalt-catalyzed hydrocarboxylation and hydroesterification of olefins. (DMC)

31051 $\nu Z + \nu_4$ band of $^{12}CF_4$. Patterson, C.W.; McDowell, R.S.; Nereson, N.G.; Begley, R.F.; Galbraith, H.W.; Krohn, B.J. (Los Alamos Scientific Lab., NM). *Journal of Molecular Spectroscopy ;* **80**: 71-85(1980).

From a high-resolution diode laser spectrum of cooled $^{12}CF_4$, line assignments in $\nu_2 + \nu_4$ at 1066.4 cm^{-1} have been made for tetrahedral subspecies to J = 20, and in many cases to higher J. Spectroscopic constants have been obtained from a least-squares fit of the Hamiltonian, and the relative intensities of the assigned lines have been calculated. The ground- and excited-state rotational constants, Coriolis constant, and splitting of the F_1 and F_2 vibrational substates have the values B_0 = 0.191688 +- 0.000020 cm^{-1}, B = 0.191442 +- 0.000020 cm^{-1}, zeta$_4$ = 0.3605 +- 0.0002, Δ = 0.5757 +- 0.0017 cm^{-1}. The C-F bond length in the ground vibrational state is thus r_0 = 1.31752 +- 0.00007A. The analysis of a combination band such as this provides a method of obtaining ground-state spectroscopic constants of spherical-top molecules directly from the infrared spectrum, without the necessity of measuring weak forbidden transitions. The assignments allow accurate predictions of the frequencies emitted by the CO_2-pumped CF_4 laser.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 30781

4005 Photochemistry

31052 (BNL—29842) One-electron reduction product of Tris (2,2'-bipyridine)rhodium (III). Creutz, C.; Keller, A.D.; Schwarz, H.A.; Sutin, N.; Zipp, A.P. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 26p. (CONF-8106139—1). NTIS, PC A03/MF A01. Order Number DE81027308.

From Symposium on inorganic reaction mechanisms; Detroit, MI, USA (10 Jun 1981).

The physical and chemical properties of $Rh(bpy)_3^{2+}$ generated via flash-photolytic and pulse-radiolytic methods in aqueous solutions are reported and discussed. The reduction potential (about -0.86 V vs SHE) and electron-exchange rate ($> = 10^9\ M^{-1}\ s^{-1}$) for the $Rh(bpy)_3^{3+}/Rh(bpy)_3^{2+}$ couple suggest the formulation of $Rh(bpy)_3^{2+}$ as the ligand-localized radical [Rh/sup III/ $(bpy)_2(bpy^-)]^{2+}$. By contrast, the ultraviolet-visible absorption spectrum, disproportionation chemistry, and the substitution lability of the metal center require that $Rh(bpy)_3^{2+}$ have substantial metal-centered radical ($4d^7$ Rh(II)) character.

31053 Theoretical study of excitons in chlorophyll a photosystems on a picosecond timescale. Shipman, L.L. (Argonne National lab., IL). *Photochemistry and Photobiology ;* **31**: 157-167(1980).

The creation and decay of singlet excitons in structurally-explicit Chl a photosystems were investigated by numerical integration of the appropriate Master Equations. The antenna chlorophylls were excited by a simulated 6 ps Gaussian light pulse. Positions and orientations for the antenna chlorophylls were randomly generated within regions whose size and shape were chosen to be appropriate for the particles observed in freeze-fractured photosynthetic membranes. Among the variables considered were chlorophyll concentration, depth of the trap (i.e. P680 or P700), and the anti R_0 parameter for Foerster transfer. Among the properties considered were antenna fluorescence lifetime; detrapping rates; the instantaneous and integrated quantum yields for antenna fluorescence and intersystem crossing; and the instantaneous and integrated quantum yields for trap fluorescence, intersystem crossing, and photochemistry. A variety of experimental evidence was used as input to the computational model. 5 figures, 2 tables.

31054 (DOE/ER/10745—1) Charge separation in photoredox reactions. Technical progress report, September 1, 1980-July 1, 1981. Kevan, L. (Houston Univ., TX (USA). Dept. of Chemistry). Jul 1981. Contract AS05-80ER10745. 25p. NTIS, PC A02/MF A01. Order Number DE81028456.

During the past eight months it has been demonstrated that electron spin echo modulation techniques can be successfully applied to the study of structural aspects of photoinduced charge separation in micellar systems. It has been shown that the structure of sodiium dodecyl sulfate micelles in aqueous solution is retained upon rapid freezing to 77K and 4K as well as upon subsequent melting at room temperature. This allows the study of electron-nuclear dipolar interactions which lead to structural information in the frozen solutions. The photoionization of tetramethylbenzidine in these micellar solutions gives a cation which can be detected by an electron spin resonance as well as by electron spin echo techniques. The latter method has been used to demonstrate the interaction of this cation with water protons in the region of the micelle surface. The effect of micelle size on the photoionization efficiency and on cation-water interactions has been studied. Addition of various metal ion electron acceptors has been shown to exhibit specific effects with regard to the enhancement of the photogenerated charge separation process in the micelles. This is related to the preferential adsorption of certain metal ions at the micelle surface. A new spin echo method has been developed for detection of preferential adsorption of metal ions at a micelle surface and the measurement of the fraction that are preferentially adsorbed. Comparison of photoionization efficiency in anionic, cationic and nonionic micelles has been studied. Thus the possibility of obtaining new structural information about the photoinduced charge separation process of molecules solubilized in micellar system does seem to be realizable by utilization of electron spin resonance and electron spin echo methodology.

31055 (DOE/SF/00115—T10) Investigation of anomalous radiation-induced electron pulses in organic liquids. Final report. Taimuty, S.I. (Stanford Research Inst., Menlo Park, CA (USA)). Dec 1967. Contract AM03-76SF00115. 28p. NTIS, PC A03/MF A01. Order Number DE81026093.

This report describes further studies of the anomalous radiation-induced electron pulses first observed in some purified liquid paraffins by Samuel, Halliday, Keast, and Taimuty, Science 144, 839 (1964). Several cells incorporating guard rings and parallel-plate or coaxial geometry were used. Liquid paraffins studied were n-hexane, n-octane, n-hexadecane, cyclohexane, and n-octacosane. Pulses were observed in only one sample of n-octacosane and in none of the other materials. The phenomenon could not be reliably reproduced in the n-octacosane samples, and attempts to establish unequivocally the nature of the phenomenon were unsuccessful.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 31052, 31055, 31259, 31517

31056 (DOE/EV/04733—T1, pp 29-34) Simulation of low-energy electron tracks in water vapor. Zaider, M. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

A continuous effort is presently under way in our laboratory to provide computational capabilities for the calculation of tracks of various particles. This article is a progress report describing the interactions of low-energy electrons in water vapor. Since at this stage the codes are still undergoing extensive tests caution should be exercised in the interpretation of the preliminary results. Three processes are considered for the interaction of electrons with water vapor: elastic scattering, ionization, and excitation. At the present time, Auger electrons are not considered specifically.

31057 (ORNL—5726) Radiation chemistry of salt-mine brines and hydrates. Jenks, G.H.; Walton, J.R.; Bronstein, H.R.; Baes, C.F. Jr. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 73p. NTIS, PC A04/MF A01. Order Number DE81026536.

Certain aspects of the radiation chemistry of NaCl-saturated $MgCl_2$ solutions and $MgCl_2$ hydrates at temperatures in the range of 30 to 180°C were investigated through experiments. A principal objective was to establish the values for the yields of H_2 [$G(H_2)$] and accompanying oxidants in the gamma-ray radiolysis of concentrated brines that might occur in waste repositories in salt. We concluded that $G(H_2)$ from gamma-irradiated brine solution into a simultaneously irradiated, deaerated atmosphere above the solution is between 0.48 and 0.49 over most of the range 30 to 143°C. The yield is probably somewhat lower at the lower end of this range, averaging 0.44 at 30 to 45°C. Changes in the relative amounts of $MgCl_2$ and NaCl in the NaCl-saturated solutions have negligible effects on the yield. The yield of O_2 into the same atmosphere averages 0.13, independent of the temperature and brine composition, showing that only about 50% of the radiolytic oxidant that was formed along with the H_2 was present as O_2. We did not identify the species that compose the remainder of the oxidant. We concluded that the yield of H_2 from a gamma-irradiated brine solution into a simultaneously irradiated atmosphere containing 5 to 8% air in He may be greater than the yield in deaerated systems by amounts ranging from 0% for temperatures of 73 to 85°C, to about 30 and 40% for temperatures in the ranges 100 to 143°C and 30 to 45°C, respectively. We did not establish the mechanism whereby the air affected the yields of H_2 and O_2. The values found in this work for $G(H_2)$ in deaerated systems are in approximate agreement with the value of 0.44 for the gamma-irradiation yield of H_2 in pure H_2O at room temperature. They are also in agreement with the values predicted by extrapolation from the findings of previous researchers for the value for $G(H_2)$ in 2 M NaCl solutions at room temperature.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 30009, 31246

31058 **Preparation of labeled aldehydes and ketones from enamides.** Golding, B.T.; Wong, A.K. (Univ. of Warwick, Coventry, England). *Angewandte Chemie, International Edition in English ;* **20**: No. 1, 89-90(Jan 1981).

A convenient, efficient method for preparing ^{17}O-labelled aldehydes and ketones has been found which is based on the hydrolysis of enamides. Advantages are that the precursor enamides are easy to prepare and can be stored, the hydrolysis by product is easily separated, and pure aldehyde or ketone is readily obtained in acceptable yield. (DLC)

31059 **In vitro solubility of yellowcake samples from four uranium mills and the implications for bioassay interpretation.** Eidson, A.F.; Mewhinney, J.A. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM (USA). Inhalation Toxicology Research Inst.). *Health Physics ;* **39**: No. 6, 893-902(Dec 1980).

The rates of dissolution of uranium product (yellowcake) obtained from four uranium ore processing mills were determined. Thirty-day dissolution experiments were conducted in vitro using two solvents: 0.1 M HCl and a simulant of an ultrafiltrate of blood serum containing diethylenetriaminepentaacetic acid (SUF + DTPA). The samples were characterized using X-ray powder diffraction and infrared spectroscopic techniques as mixtures of ammonium diuranate and U_3O_8. The combined results show that ammonium diuranate dissolved much more rapidly in either solvent than did U_3O_8. Dissolution half-times in SUF + DTPA were: ammonium diuranate approximately equal to 10 hr, U_3O_8 approximately equal to 10^4 hr. These values are comparable to those derived from available human exposure data and suggest that ammonium diuranate should be included in the Class D solubility category. The percentage of total material present as the more soluble form was shown to vary from 26 to 86% in agreement with quantitative infrared analyses. The dissolution results indicate that caution must be exercised in the interpretation of bioassay results of workers from different uranium mills.

31060 **Method for the preparation of radon-211.** Meyer, G.J.; Lambrecht, R.M. (to Dept. of Energy). US Patent Application 195,967. 10 Oct 1980. 15p.

A method is claimed for the production of ^{211}Rn which can be easily isolated from the target and obtained in high yields. It is claimed that the radioisotope ^{211}Rn can be prepared by the bombardment of ^{209}Bi with ^{7}Li particles using the nuclear reaction $^{209}Bi(^{7}Li,5n)^{211}Rn$. The ^{211}Rn can be isolated from the target quite easily by degassing at elevated temperatures and the radiochemical purity of the product is better than 98%. It can thus be used as a generator system for ^{211}At which is of potential interest in biomedical applications. The excitation function for this reaction is about from 40 to 60 MeV and the cross section for ^{211}Rn production reaches 650 mb at 53 MeV producing a saturation yield of 5.5 μCi/nA.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 29915

31061 **(DOE/ER/04169—T1) Rate coefficients of combustion/fuel conversion reactions by high-temperature photochemistry. Progress report, September 1, 1980-June 30, 1981.** Felder, W. (Aerochem Research Labs., Inc., Princeton, NJ (USA)). Jul 1981. Contract AC02-77ER04169. 7p. (COO—4169-6). NTIS, PC A02/MF A01. Order Number DE81027965.

Reliable kinetic data on isolated elementary combustion reactions spanning a broad temperature range are required for modeling and scaling studies aimed at improving the performance of, and reducing the pollutant formation from, fossil-fuel burning devices. Such data are generally not available. In the present work a new technique, High Temperature Photochemistry (HTP), has been developed to provide such data. It combines the technology of the High-Temperature Fast-Flow Reactors (HTFFR) we developed to study kinetics of metal atom/oxide reactions in the 300 to 1900°K range with the flash photolysis technique, which although used widely for study of such combustion reactions, has previously been limited to studies at or near room temperature. This report discusses aspects of a partially complete HTP study on the reaction, $OH + C_6H_6 \rightarrow C_6H_5 + H_2O$ in the 600 to 1300°K range, and initial work on CH_3 oxidation by O_2 and O atoms. The measurements suggest an initial value of $k_1(T) = (4.2 +- 1.5) \times 10^{-11} \exp[-(4.0 +- 0.7) \times 10^3/T]$, $cm^3\ molecule^{-1}\ s^{-1}$, in fair agreement with recent results obtained elsewhere in the 500 to 1150°K range.

31062 **(DOE/ET/11056—T4) Laser diagnostics in jets and flames.** Celentano, A.; Lederman, S. (Polytechnic Inst. of New York, Farmingdale (USA)). Apr 1981. Contract AC01-78ET11056. 160p. NTIS, PC A08/MF A01. Order Number DE81027621.

An integrated four component pulsed vibrational Raman scattering - one dimensional Laser Doppler Velocimeter scattering measurement system is applied to non-reacting and reacting free jet flows. Simultaneous, instantaneous, non-intrusive, remote, and at a point measurements of velocity, temperature and specie concentration - mean value, turbulent intensity and histogram distributions are shown. In addition, specie concentration second and third order scalar cross-correlation distributions are presented as a measure of specie mixing or unmixedness. It is found that many experimental parameters needed for theoretical flow modeling can be obtaind by this measurement system. A highly implicit numerical code was written and applied to model the non-reacting turbulent jet flow. Good agreement is shown between the numerical results and experimental measurements. The code is extended to model a premixed methane-air reacting free jet flow using a one-step global laminar Arrhenius rate chemical source term. It is found that agreement existed between the numerical solution and experimental measurements, but that refinements to the turbluent model and the use of a turbulent chemical source term are required to obtain better agreement.

31063 **(SAND—81-8230) Fundamental combustion and diagnostics research at Sandia. Progress report, January-March 1981.** Hartley, D.L. (Sandia National Labs., Livermore, CA (USA)). Jun 1981. Contract AC04-76DP00789. 44p. NTIS, PC A03/MF A01. Order Number DE81028204.

The program addresses four categories: (1) detailed chemistry of combustion; (2) fundamental processes associated with laminar and turbulent flames; (3) development of research techniques specifically applicable to combustion environments; and (4) operation of the user-oriented Combustion Research Facility. The first section contains activities in Combustion Research, the second section contains activities in Molecular Physics and Spectroscopy, the third section contains activities in Diagnostics Research, and the fourth section is concerned with Facility Construction and Operation. The results reported in these four sections are either completed or at an advanced stage.

42 ENGINEERING

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 29901, 29938, 30536, 30547, 30650, 30952, 31179, 31474, 31494, 31500

31064 **(AD—338005) Shock motion of YFNB targets.** Blake, R.E. (Naval Research Lab., Washington, DC (USA)). Jun 1956. 30p. NTIS, PC A03/MF A01.

The shock-spectrum data obtained on the three YFNB surface targets of Operation Wigwam are examined and compared with two hypotheses as to the relation between parameters of the underwater pressure wave and the shock motion in a ship. It was found that the shock severity varies approximately in proportion to the theoretical upward velocity (the 'spray-dome velocity') of the free water surface. Certain deviations from full agreement are noted. The alternative hypothesis that shock motion is proportional

to the 'shock factor,' which is correct for ordinary high explosives, is found to be in poor agreement. The order of magnitude of shock-spectrum velocities was found to agree fairly well with computed dome velocities. An analysis of the interaction of a ship's bottom plate with a step shock wave shows that the dome velocity hypothesis is a rough approximation of the correct theory.

31065 **(AD—338012) Bubble phenomena.** Hamilton, G.R.; Tirey, G.B.; Hanlon, P. (Columbia Univ., New York (USA). Coll. of Physicians and Surgeons). Mar 1956. 34p. NTIS, PC A03/MF A01.

Project 1.4 was to measure the maximum size of the underwater explosion bubble and any other bubble size or motion data possible. This was to be done with water-displacement meters at 2000-ft depths located approximately 6000 and 8000 ft from the weapon. This measurement was to be made to make possible, when combined with knowledge of the energy in the shock wave, the calculation of the weapon's total energy yield.

31066 **(DOE/ER/10612—4) Cryostat pressure/temperature interactive control operating instruction and control logic.** Oi, T. (State Univ. of New York, Stony Brook (USA)). 15 Jul 1981. Contract AC02-80ER10612. 192p. NTIS, PC A09/MF A01. Order Number DE81028055.

A FORTRAN program has been written and modified in order to make use of a computer for the thermal control of the cryostat, the precision measurement of vapor pressure isotope effect (VPIE) and VPIE data acquisition, with the emphasis being placed on the automatic thermal control of the cryostat by the computer. The program is structured so that the operator can access various routines which perform specific tasks through interaction with the program main from the console terminal. The operating instruction and the control logic of the program are explained in full detail. The flow chart and the printout on the console terminal of each routine are shown. The cryostat was operated to demonstrate how excellently the program works by using the program. The fluctuation of the sample holder temperature was actually able to be kept within a few millidegrees for a certain period of time (more than 30 minutes) fully automatically. The semi-automatic thermal control of the cryostat with a routine of the program was proved to be superior to the fully manual control from the control panel.

31067 **(DOE/ET/11268—T2) Drawing levels standards and specifications handbook. Final report.** (Skelly and Loy, Harrisburg, PA (USA)). Aug 1981. Contract AC01-79ET11268. 106p. NTIS, PC A06/MF A01. Order Number DE81027354.

The handbook discusses the levels of design evolution for an R and D project from original conception through prototype testing to production of the finished product. Sample illustrations and drawings are presented illustrating the various levels of design. For the various levels of design, specifications are recommended for inclusion in contracts as needed. Sources of technical specifications are presented. Drafting standards and the ordering of hard copy and microfilmed drawings are discussed. An Appendix is provided as a tutorial, with examples, on the types of drawings that can make up a drawing package.

31068 (DOE/EV/04733—T1, pp 14-23) **Move of the Radiological Research Accelerator Facility to the Nevis Laboratory of Columbia University.** Goldhagen, P.; Rohrig, N.; Marino, S.; Hall, E.J.; Rossi, H.H. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

The Radiological Research Accelerator Facility (RARAF) was established in 1967 as a joint enterprise of the Medical Research Center of Brookhaven National Laboratory (BNL) and the Radiological Research Laboratory of Columbia University (RRL) to fill the need for an accelerator facility dedicated to radiobiology and radiological physics research. It was developed from the 4 MV Van de Graaff accelerator that had been the injector for the Cosmotron at BNL, and was located in the southern corner of the Cosmotron building, where the synchrotron ring had been. In 1977, responsibility for management of the facility was transferred to the Safety and Environmental Protection Division of BNL, and the space available to RARAF was reduced slightly. Late in 1979, BNL decided to dismantle RARAF in order to use all the Cosmotron building for the Isabelle project. RARAF was saved by the decision to give all of its equipment to Columbia University and move the facility to the cyclotron building of the University's Nevis Laboratory. This paper is a report on the progress of the move and plans for the new facility.

31069 **(HEDL-SA—2301-FP) Electrical penetration feedthru for FMEF.** Smith, F.C.; Divona, C.J.; Thompson, W.M. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Contract AC14-76FF02170. 19p. (CONF-810606—90). NTIS, PC A02/MF A01. Order Number DE81027286.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

A new concept was employed in the design of the electrical penetration feedthru for the Fuels and Materials Examination Facility (FMEF). Prototype units were fabricated and successfully tested. The new design provides a significantly larger number of connections, is much simpler, and is more economical compared to existing feedthru.

31070 **(K/SUB—7821/X03/1) Moment-rotation characteristics of column base plate to foundation connections.** Stephenson, J.M.; Tarpy, T.S. Jr. (Oak Ridge National Lab., TN (USA); Vanderbilt Univ., Nashville, TN (USA). School of Engineering). 30 Jan 1981. Contract W-7405-ENG-26. 167p. NTIS, PC A08/MF A01. Order Number DE81027685.

This study concerns itself with the experimental investigation of connections between steel columns and concrete foundations which are conventionally classified as pinned. This implies that a bending moment cannot be transferred between the column and foundation. Five pairs of pinned connections and one type of moment resisting or fixed connection were tested. Each connection was tested in both the major and minor axis of bending of the connection column. The objectives of the tests reported herein were to determine and quantify the moment-rotation characteristics of pinned connections. The connection or specimen selection, specimen preparation, test set-up, equipment and instrumentation, the test procedure, and the specimen behavior are described herein. Moment-rotation curves are presented for each specimen as well as recommended rotational spring constants for these connections. From the results of this investigation, it may be concluded that the pinned connections tested offer a degree of fixity which should not be ignored when evaluating existing structures under lateral loads for compliance with current building codes. The use of the rotational spring constants presented in this report should enable a more realistic analysis of structures, and, hopefully, prevent unwarranted modifications of existing structures to bring them within compliance with current requirements.

31071 **(LA-UR—81-2343) Pressure measurements of non-planar stress waves.** Carlson, G.H.; Charest, J.A. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 24p. (CONF-810931—1). NTIS, PC A02/MF A01. Order Number DE81028729.

From 1. symposium on gages and piezoresistive materials; Archon, France (29 Sep 1981).

Measuring the pressure of non-planar stress waves using thin piezo-resistive gages requires correcting for induced strain parallel to the sensing elements. A technique has been developed that permits such measurements, making use of a dual element gage. One element, Manganin, is sensitive to stress both parallel and perpendicular to the sensing element; the other element, Constantan, is primarily sensitive to stress parallel to the sensing element. The change in resistance in the Constantan element is thereby used to correct for the strain effect parallel to the Manganin element axis. Individual and combined Manganin and Constantan elements were subjected to controlled gas gun impact tests in the pressure and strain ranges of 0 to 50 kbar and 0 to 7%, respectively. From planar wave tests, the piezoresistivity of Constantan was found to be positive but negligible in comparison with Manganin. From combined stress and strain environments, the compression and tension strain factors of Constantan were found to be constant and equal to 2.06. The strain factors of Manganin were found to in-

crease from 1.2 to 2.0 asymptotically in the range of 0 to 3% strain. It was experimentally demonstrated that, because of the closeness of their strain factors, the Manganin-Constantan dual element gage could be used in the differential recording mode to yield pressure directly. In this mode the gage is a strain compensating gage. Analytical techniques have also been developed for more accurate strain compensation.

31072 (SAND—81-0728C) Electrooptic shutter devices utilizing PLZT ceramic wafers. Thornton, A.L. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 7p. (CONF-810810—T3). NTIS, PC A02/MF A01. Order Number DE81025470.

From SPIE international symposium; San Diego, CA, USA (24 Aug 1981).

Optical transparency was achieved in lead zirconate-titanate ferroelectric ceramics by substituting moderate amounts of the element lanthanum (8 to 12%) for lead. These compositions exhibit the quadratic (Kerr) electrooptic effect. The excellent optical qualities of these materials (designated PLZT) has permitted the practical utilization of their electrooptic properties in a number of devices. All of these devices utilize the classic Kerr cell arrangement. A PLZT wafer with optical axis oriented at 45° with respect to the axes of polarization is sandwiched between crossed polarizers. Application of an electric field via an interdigital array of electrodes on opposing wafer surfaces forces the PLZT material into a tetragonal state with the resulting induced birefringence proportional to the square of the applied electric field. Hence, the electrooptic wafer provides a retardation of light so that a component is passed by the second crossed polarizer to achieve an ON or open state. Maximum transmission is achieved when the retardation is half-wave. Shutter devices developed by Sandia and those in continuing development are described with respect to operational characteristics and physical configuration. The devices range in size from very small apertures of 50 μm x 2 mm with center-to-center repeat dimensions of 125 μm - to very large - apertures of 15.2 cm in single pieces and mosaics with apertures of 15.2 cm x 20.3 cm. Major efforts have centered on shutter development for the protection of aircrew from eye-damaging weapon effects. Other devices are also described which: provide eye protection for welders, protect vidicon tubes, function as page composers for holographic memories serve as large aperture photographic shutters, provide stereoscopic three-dimensional TV displays, and serve as data links in a fiber-optic transmission path.

31073 (UCID—19095-81) CADD/M project review: January 1981. Crowe, R.A. (Lawrence Livermore National Lab., CA (USA)). 30 Jan 1981. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01. Order Number DE81027438.

The Computer-aided Design, Drafting/Manufacturing (CADD/M) Project and its current status are reviewed. The Project's history is reviewed and its present programmatic impact is discussed. The investment to date (including FY 1981) is reported along with maintenance costs. Some user activities are also reviewed. The Programs receiving the majority of the benefits are Nuclear Design (ND), Military Applications (MA), and Nuclear Test Programs. In general the benefits include increased design/drafting personnel productivity, reductions in design turn-around time, and improved design quality and documentation. Each Division does, however, receive slightly different benefits because of different missions and operations. State-of-the-art technology that may impact planning is noted and the status of the research and development efforts is presented. The report concludes with the latest plan for further implementation of CAD/CAM technology.

31074 (UCRL—53094) Applications of systems theory to structural analysis. Weaver, H.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jul 1981. Contract W-7405-ENG-48. 57p. NTIS, PC A04/MF A01. Order Number DE81028496.

The transfer function model of a structure can be used to predict the response motions of the structure resulting from either a single loading or combination of loading, or forcing, conditions or a combination of the two. The use of transfer function models has two main advantages. First, because the models are used in conjunction with frequency domain, or Fourier, analysis techniques, tremendous computational efficiency via the fast Fourier transform (FFT) algorithm is possible. Second, a model can be constructed directly from data obtained by simple vibrational tests performed on a structure.

31075 Unique test capabilities at Sandia National Laboratories. Bushnell, J.C.; Bickel, D.C. *Journal of Environmental Sciences ;* **24**: No. 3, 11-14(May 1981).

A comprehensive testing capability has evolved at Sandia National Laboratories over the last three decades. This capability is primarily dedicated to obtaining test response data to substantiate analytical methods employed at the Laboratories. Unique instrumentation and data transmission techniques have been developed to recover test data. Emphasis has been placed on expeditious processing of test results for correlation with the analytical processes. Numerous facilities address the general environments of acceleration, climate, shock, and vibration. Nondestructive testing includes acoustic emission detection, laser holography, ultrasonics, and radiography. More specific testing exists in the fields of aerodynamics, materials characterization, radiation effects, and energy research. Much of the capability is classical and can be found with degrees of similarity at other laboratories. However, there are certain unique testing capabilities that have been developed to satisfy special requirements. The unique testing facilities described include: rocket sled tracks for ballistics tests and impact tests; aerial cable facilities for free-drop tests of payloads up to 3000 lb from heights up to 600 ft.; explosives testing facilities; large centrifuges; equipment for simulating heating conditions such as reentry heating; a lighting simulator; and an electromagnetic environment simulator. (LCL)

31076 (USC—113P-64) Invariant imbedding, iterative linearization and multistage countercurrent processes VI. Complex distillation column and multipoint boundary-value problem. Lee, E.S. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Sep 1973. Contract AT03-76ER70019. 19p. NTIS, PC A02/MF A01. Order Number DE81026646.

A complex distillation column problem is formulated as a multipoint boundary value problem in difference equations. It is shown that this nonlinear multipoint boundary value problem can be solved easily by the quasilinearization technique. With very rough initial approximations, only ten iterations are needed to obtain a four digit accuracy in concentrations. The advantage of this approach is that complex column can be solved in essentially the same way as simple column with approximately the same computation requirements.

31077 Reciprocating pellet press. Jones, C.W. (to Dept. of Energy). US Patent 4,260,349. 7 Apr 1981. Filed date 7 Jan 1980. vp.

A machine for pressing loose powder into pellets using a series of reciprocating motions has an interchangeable punch and die as its only accurately machines parts. The machine reciprocates horizontally between powder receiving and pressing positions. It reciprocates vertically to press, strip and release a pellet.

31078 Method of measuring heat influx of a cryogenic transfer system. Niemann, R.C.; Zelipsky, S.A.; Rezmer, R.R.; Smelser, P. (to Dept. of Energy). US Patent Application 201,947. 29 Oct 1980. 12p.

A method is provided for measuring the heat influx of a cryogenic transfer system. A gaseous phase of the cryogen used during normal operation of the system is passed through the system. The gaseous cryogen at the inlet to the system is tempered to duplicate the normal operating temperature of the system inlet. The temperature and mass flow rate of the gaseous cryogen is measured at the outlet of the system, and the heat capacity of the cryogen is determined. The heat influx of the system is then determined from known thermodynamic relationships.

31079 Apparatus and method for maintaining low temperatures about an object at a remote location. Steyert, W.A. Jr.; Overton, W.C. Jr. (to Dept. of Energy). US Patent Application 202,041. 29 Oct 1980. 13p.

The disclosure is directed to an apparatus and method for maintaining a body at cryogenic temperatures at a remote location

such as down a borehole for an extended period of time. A housing contains a body comprising a material having a high specific heat at cryogenic temperatures such as between about 2 and 15 K. The body contains an orifice for containing an instrument or instruments operable at superconducting temperatures. The apparatus is precooled at the surface and lowered into a borehole to a desired depth, such as 2 to 3 miles. The instruments are operated, and the apparatus withdrawn, the material of the body maintaining the very low temperatures at which the instrument(s) operate for a sufficient period of time at the remote or downhole location. The material may comprise a rare earth compound, such as Gd_2O_3, Gd_2Se_3, Gd_2O_2S or $GdAlO_3$. Monoclinic and C-phase gadolinium oxides work well. A low temperature is maintainable at a remote location for several hours.

31080 **Passive ice freezing-releasing heat pipe.** Gorski, A.J.; Schertz, W.W. (to Dept. of Energy). US Patent Application 191,611. 29 Sep 1980. 14p.

A heat pipe device has been developed which permits completely passive ice formation and periodic release of ice without requiring the ambient temperature to rise above the melting point of water. This passive design enables the maximum amount of cooling capacity to be stored in the tank.

31081 **Assessment of accident thermal testing and analysis procedures for radioactive materials shipping package.** Pope, R.B.; Yoshimura, H.R.; Hamann, J.E.; Klein, D.E. (Sandia Lab, Albuquerque, NM). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-38, 1-9(Jul 1980).

Currently, Type-B packages for transporting radioactive materials are required by regulations to survive exposure to an engulfing 30-min, 800 C thermal source. This requirement is specified as a test, but allowances are provided to permit the requirement to be met by analyses. Various test methods, including pool fires and furnaces, are used when testing of packages is desired. The exposure of packages to pool fires, with and without wind deflectors and/or transportation vehicle structure is reviewed. Specific test data obtained with lead-shielded casks in open pool fires in both the United States and Japan are used to assess fire source temperatures, nonuniformities, wind effects and convective and radiative coefficients. 15 refs.

31082 **Normal stress effects in viscoelastic fluid lubrication.** Christensen, R.M. (Lawrence Livermore Lab., CA); Saibel, E.A. *Journal of Non-Newtonian Fluid Mechanics ;* 7: 63-75(1980).

Non-Newtonian flow effects are evaluated in a slider-bearing configuration. The material model taken is that of the Coleman-Noll second-order fluid. An explicit result is given for the portion of the bearing load supported by the non-Newtonian normal stresses as well as that portion resulting from the usual lubrication theory (Newtonian effect). Particular attention is given to the non-Newtonian effect of a high-polymer additive applied to a Newtonian base stock. The non-Newtonian effect has a particular dependence on the bearing geometry as well as a dependence on the relaxation time of the additive and the amount by which the additive increases the viscosity. The strength of the non-Newtonian effect is asessed in realistic conditions of bearing operation. We find that under certain conditions the non-Newtonian effect could provide a significant load-supporting capability. However, with slight changes in the conditions of the bearing operation, the non-Newtonian load support is negligible. These results are interpreted and qualified with respect to the limitations of the second-order theory, which does not include shear thinning effects.

31083 **(ORNL-tr—4752) Holding amount of refrigerant in refrigeration system.** Otaki, T.; Yoshii, T. Translated from *Reito ;* **50**: No. 574, 597-598, 614-615(1975). 9p. NTIS, PC A02/MF A01. Order Number DE81025088.

The procedure for the prediction of charge amount of refrigerant in refrigerating system is presented. The hold up in two-phase region of evaporator and condenser is determined by adopting Hughmark's correlation, which, compared with Lockhart-Martinelli's correlation or other correlation, appears to agree better with experimental result. The availability of this technique is shown, as examples, in the following cases: design technique for reducing the charge amount of refrigerant, which enhances the reliability of the refrigeration system; elimination of the refrigerant charge unbalance on heating and cooling of heat pump air-conditioner; and volume of accumulator and receiver can be determined, by estimating the distribution of refrigerant in the refrigeration system.

4203 Lasers

REFER ALSO TO CITATION(S) 30993, 31490

31084 **(AD—871960) Cooling systems studies for neodymium doped glass and YAG lasers. Final technical report Jan-Dec 69.** Woodard, R.S.; Kendall, P.J.; Fagin, K.W. (Martin Marietta Aerospace, Orlando, FL (USA)). Mar 1970. Contract F33615-69-C-1329. 297p. NTIS, PC A13/MF A01.

An analytical evaluation of a variety of techniques was performed for cooling laser cavities and for rejecting heat from laser systems. Advantages, disadvantages, and unique areas of applicability for each technique were summarized to provide criteria for the design of a laser cooling system. Seven liquid coolants were tested in a dynamic cooling loop closely simulating an actual laser system. Those coolants showing the best performance were further tested for changes in thermophysical properties and compatibility with cooling system materials.

31085 **(AD—916433) Plasma-parameter measurements in transverse hollow-cathode discharges. Final technical report Nov 70-Jan 73.** Olson, R.A.; Nordlund, D.R. (Systems Research Labs., Inc., Dayton, OH (USA)). Oct 1973. Contract F33615-71-C-1168. 99p. NTIS, PC A05/MF A01.

A primarily experimental investigation of transverse hollow-cathode discharges was conducted to obtain detailed knowledge of the microscopic plasma properties of fundamental importance in gaseous laser action. Spherical probes (0.15 to 0.32 mm diam) were used to measure the plasma properties within a slotted hollow cathode for various gases as a function of pressure, current, radial position, and tube diameter. The primary diagnostic tool employed was the Langmuir-probe second-derivative technique. A harmonic second-derivative system was used to obtain probe data.

31086 **(AD-A—090840) Thallium mercury laser development. Final report 1 Feb 1979-31 Jan 1980 on phase 2.** Liu, C.S.; Feldman, D.W.; Pack, J.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 17 Apr 1980. Contract N00014-78-C-0131. 18p. NTIS, PC A02/MF A01.

The major effort was to perform definitive gain measurements on discharge-excited T1-Hg laser mixtures and to demonstrate T1Hg laser output at 459 micrometers if the gain measurement indicated that laser tests were warranted. Gain and absorption measurements of the discharge containing high densities of mercury (3 x 10 to the 19th power cm -3) and thallium (6 x 10 to the 16th power cm -3) were undertaken. No transient gain was observed within the T1Hg* excimer band at 459 nm; on the contrary, a strong absorption from Hg2* molecules in this region was detected.

31087 **(AD-A—091012) Electron impact of laser media. Final scientific report, 15 June 1979-14 June 1980.** Golden, D.E. (Oklahoma Univ., Norman (USA). Dept. of Physics and Astronomy). 14 Aug 1980. 72p. NTIS, PC A04/MF A01.

The experimental program is aimed at an understanding of the physics necessary for the design of lasers which are excited by electron impact. Electron impact excitation cross sections, optical branching ratios of the subsequent decays, excited state lifetimes, polarization of radiation, collisional deactivation, and energy transfer rates are measured. Cross sections for the excitation of fine structure levels and alignment and orientation parameters are also measured.

31088 (AD-A—091125) Effects of the current distribution on the characteristics of the semiconductor laser with a channeled-substrate planar structure. Interim report. Chen, C.Y.; Wang, S. (California Univ., Berkeley (USA). Electronics Research Lab.). Aug 1980. Contract F49620-79-C-0178. 31p. NTIS, PC A03/MF A01.

Effects of the current distribution along the junction plane on the lateral and longitudinal mode behaviors of the semiconductor laser with a channeled-substrate planar (CSP) structure are investigated experimentally and theoretically. A new laser structure of the double-current-confinement CSP type, which has two electrodes for pumping and only one channel for stimulated emission (TEPOSE), was employed for this study. Current distribution profile of this laser can be varied by changing the relative strength of the current in each electrode. Experimental results showed that an asymmetric current profile can degrade the fundamental-lateral mode operation. A theoretical model based on phase-locked two-mode excitation was deveoped to account for the far-field pattern of a TEPOSE laser with only one electrode excited. It is also found that nonuniform excitation over the lasing mode can lead to multi-longitudinal mode, probably due to nonuniformity in the quasi-Fermi level separation. The present study demonstrates the importance of symmetric and uniform current distribution in designing semiconductor lasers.

31089 (AD-A—091296) Development and analysis of closed cycle circulator elements. Final report 31 Jul 978-31 May 1980 . Shih, C.C.; Karr, G.R.; Perkins, J.F. (Alabama Univ., Huntsville (USA). School of Science and Engineering). May 1980. Contract DAAK40-78-C-0219. 326p. NTIS, PC A15/MF A01.

A series of experiments with various flow rates of laser gas and coolants under several levels of energy inputs has been conducted on the Army Closed Cycle Circulator for pulsed EDL to collect sufficient data for flow calibration and coefficient determination. Verification of the theoretical models depicting the functions of the heat exchangers in maintaining the thermal balance in the flow through the steady and transient states are made through comparison with results of the experimental analysis.

31090 (AD-A—091407) Unidirectional composites as electrodes/preionization sources for CO^2 TEA lasers. Doctoral thesis. Wax, S.G. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). Dec 1979. 222p. NTIS, PC A10/MF A01.

Transverse Excited Atmospheric (TEA) CO_2 lasers offer improvements over low pressure CO_2 lasers, but efficient operation at atmospheric pressure is often difficult to achieve. The purpose of this research was to examine the feasibility of using unidirectional oxide metal composites grown at the Georgia Institute of Technology to obviate the problems of high pressure CO_2 laser operation. The research was divided into two areas. In the first, Gd_2O_3-Ce_2O_3-Mo and UO_2-W composites were examined for use directly as electrodes in CO_2 lasers. Using discharge apparatus similar to that used for CO_2 lasers, the discharge characteristics from polished and exposed pin composite electrodes were examined. The results of the cathode fall tests indicated that cathode fall for every composite electrode tested was higher than for the aluminum standard. No significant advantage with the composite electrodes at high pressure was observed. In the second phase of the research, low voltage field emitters (LVFE) were examined as a preionization source for the discharge. These emitters were prepared using thin film techniques from the UO2-W composites. In this phase, field emission at atmospheric pressure, the control of a discharge by field emission and the survivability of the LVFE structure at high pressure were all considered.

31091 (AD-A—091795) Neutron and gamma radiation effects on GaaLaS laser diodes. Final report. Ackerman, H.; Walsh, T.E. Jr. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Aug 1980. 83p. NTIS, PC A05/MF A01.

The effects of two kinds of radiation on the performance of double heterojunction aluminum-gallium-arsenide (AlGaAs) laser diodes were investigated. One set of diodes received neutron radiation in a nuclear reactor; another set was exposed to gamma radiation from a cobalt-60 source. Each set contained two types of lasers, an RCA C30127 and a Laser Diode Laboratories LCW-10, both designed to operate continuously at room temperature. At neutron fluences of 10 to the 14th power n/sq cm, both types of diodes showed significant decreases in power output and external quantum efficiency, and increases in threshold current. There was no significant change in bias voltage versus forward current or in spectral composition of the light outputs at neutron fluences up to 10 to the 15th power n/sq cm. Under gamma radiation, the C30127 laser exhibited rapid degradation. A dosage of 10 to the 4th power rad(Si) reduced the output power by half. Threshold current, efficiency, and intensity distribution were all adversely affected. The damage factor at constant voltage was 1.5 x 10 to the minus 7th power rad to the minus 1 power. The LCW-10 performance improved to a dosage of 10 to the 6th power rad(Si) before degradation began. After 10 to the 8th power rad(Si), power output was still comparable to preirradiation values. Beam characteristics were not appreciably altered. The damage factor at constant voltage was 4 x 10 to the minus 8th power rad to the minus 1 power.

31092 (DOE/SF/90025—T1) Infrared-frequency conversion. Final technical report, 10 March 1976-30 September 1977. McNair, R.E.; Klein, M.B. (Hughes Research Labs., Malibu, CA (USA)). Nov 1977. Contract AC03-76SF90025. 25p. NTIS, PC A02/MF A01. Order Number DE81026074.

The purpose of this program was to develop frequency conversion techniques that could efficiently generate new infrared wavelengths suitable for isotope separation, starting with presently available molecular lasers. The approach is nonlinear mixing in cryogenic liquids using third-order difference frequency mixing. The general concepts of third-order nonlinear mixing have been demonstrated for gaseous molecular media, but until recently, have not been considered for liquid media in the infrared. The principal wavelength region in the infrared of interest for isotope separation is near 16 μm with an alternative region near 8.6 μm. Four-wave mixing of the type $2\omega_1 - \omega_2$ in liquid CO at 77°K with an output wavelength of 8.64 μm was demonstrated. For the two-photon resonant third-order process, a nonlinear susceptibility of absolute value chi = 6.2 x 10^{-14} esu was measured. For a pure liquid CO medium and a total input power of 460 kW, the highest observed efficiency was eta = 6.2 x 10^{-5}. The studies indicate four-wave mixing as a reasonable and promising alternative to existing methods (i.e., nonlinear crystals, tunable semiconductor diode lasers, and optical parametric oscillators) for generating sigmals in the 8.6 regime. (WHK)

31093 (PB—81-800583) Metal vapor lasers. 1964-October 1980 (citations from the NTIS Data Base). Report for 1964-October 1980. Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Nov 1980. 214p. NTIS PC N01/MF N01.

The bibliography of Federally-funded research cites studies on metal atom, metal dimer, and metal ion lasing, as well as metal vapor generators for lasers. Studies on optical pumping, tuning devices, and excitation are included. Sodium, cesium, copper, and mercury vapor lasers are discussed, as well as their use in the visible and ultraviolet regions. (This updated bibliography contains 207 citations, 33 of which are new entries to the previous edition.)

31094 (PB—81-850752) Carbon monoxide lasers. January 1976-August 1980 (citations from the International Aerospace Abstracts Data Base). Report for January 1976-August 1980. Sassi, W.V. (New England Research Application Center, Storrs, CT (USA)). Oct 1980. 217p. NTIS PC N01/MF N01.

The citations in this bibliography cover high-power efficient electrically-excited carbon monoxide lasers, carbon monoxide gasdynamic laser measurements, methods to increase the efficiency of sealed CO lasers, methods of vibrational kinetics and applications to CO lasers, characteristics of pulsed CO lasers, and investigations of parametric relations for steady-state CO lasers. Solar-pumped CO lasers for space power transmission are also included in this bibliography. (Contains 300 citations.)

31095 **(PB—81-850760) Carbon monoxide lasers. June 1976-August 1980 (citations from the Energy Data Base). Report for June 1976-August 1980.** Sassi, W.V. (New England Research Application Center, Storrs, CT (USA)). Oct 1980. 226p. NTIS PC N01/MF N01.

The citations in this bibliography cover high-power efficient electrically-excited carbon monoxide lasers, carbon monoxide gas-dynamic laser measurements, methods to increase the efficiency of sealed CO lasers, methods of vibrational kinetics and applications to CO lasers, characteristics of pulsed CO lasers, and investigations of parametric relations for steady-state CO lasers. Solar-pumped CO lasers for space power transmission are also included in this bibliography. (Contains 244 citations.)

31096 **Temperature dependence of the rate constants for three-body quenching reactions in the KrF* laser system.** Klimek, D.; Hsia, J.C. (Avco Everett Research Laboratory, Inc., Everett, Massachusetts 02149). *Journal of Applied Physics ;* **52**: No. 8, 5361-5364(Aug 1981).

The KrF* and Kr_2F^* fluorescence emissions from e-beam excited F_2/Kr/Ar mixtures were measured over the temperature range of 315°—420 °K, at total densities of 1, 2, and 3 amagat. These data were used in conjunction with kinetic model calculations to evaluate the temperature dependence of three-body quenching reactions of the type: $KrF^* + R + M \rightarrow RKrF^* + M$, where RequivalentAr, Kr, and MequivalentAr, Kr. The decrease in the three-body rates with increasing temperature deduced from the experimental data, agrees to within 15% of that calculated by using classical phase-space theory.

31097 **Theory and scaling of KrF lasers with distributed element pulse forming networks.** Greene, A.E.; Tallman, C.R.; Willis, W.L.; Brau, C.A. (Los Alamos Scientific Lab., NM). *Proceedings of the Internaional Conference on Lasers ;* 211-218(1979).

Our theoretical model of transverse discharge KrF lasers has been improved and extended to examine the performance of KrF lasers with distributed element circuits (transmission line energy storage). The model simultaneously integrates the time dependent circuit equations, the kinetic equations for the important atomic and molecular species and electrons, and the equations describing the growth of the spontaneous and stimulated emission. The model has been calibrated against a broad data base, including several pulse forming network (PFN) designs and generally good agreement has been achieved with measured discharge voltage and current traces and timing and magnitude of stimulated emission. The model has been used to study the scaling of these lasers in terms of pressure and input energy. In addition, at present, modifications are underway to increase the flexibility of the PFN portion of the computer rogram. Improvements in the efficiency of these devices by PFN modification will be discussed.

31098 **Inhomogeneously pumped stimulated Raman scattering.** Eimerl, D. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Proceedings of the Internaional Conference on Lasers ;* 333-338(1978).

The parametric theory of stimulated Raman scattering involving waves with spatial and temporal inhomogeneities is introduced. The method is simple, intuitive, and describes many coherent phenomena.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 30649, 31078, 31083

31099 **(DOE/ET/12438—T2) Resume of HTFS computer programs.** Beckmann, R.B. (ENSCI, Inc., College Park, MD (USA)). 15 Feb 1979. Contract AC22-78ET12438. 34p. NTIS, PC A03/MF A01. Order Number DE81025809.

Available computer programs, developed by Heat Transfer and Fluid Flow Service (HTFS) for the design/evaluation of industrial heat transfer equipment and/or systems are reported. HTFS is jointly operated by the United Kingdom Atomic Energy Authority and the National Engineering Laboratory in Scotland. Fifteen programs are listed with explanatory notes on the uses, input data requirements, output, and program background. (LCL)

31100 **(EPRI-NP—1917) Characteristic and linear dispersion analyses of the RETRAN two-velocity model. Interim report.** Eide, S.; Hughes, E.D. (Energy, Inc., Idaho Falls, ID (USA)). Jul 1981. 95p. NTIS, PC A05/MF A01. Order Number DE81903811.

Mathematical properties of the RETRAN two-velocity two-phase flow model have been analyzed. The characteristic roots were determined numerically for a wide range of flow conditions. Regions of real characteristics (hyperbolicity) and complex characteristics have been identified. The sound speeds were also obtained from the characteristics. A linear dispersion analysis of the full compressible RETRAN two-velocity model has not yet been successful. However, the groundwork for such an analysis has been laid. Results for incompressible two-phase flow models indicate that interphase friction can have a damping effect on the system response to perturbations.

31101 **(K/CSD/TM—38) AMICON: a multi-model interpretative code for two-phase-flow instrumentation with uncertainty analysis.** Teague, J.W. II. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Aug 1981. Contract W-7405-ENG-26. 53p. NTIS, PC A04/MF A01. Order Number DE81028119.

AMICON is an interpretative code designed to calculate mass fluxes and mass flux standard deviations, as well as certain other fluid physical properties. Several models are used to compute mass fluxes and uncertainties since some models provide more reliable results than others under certain flow situations. The program was specifically prepared to compute these variables using data gathered from spoolpiece instrumentation on the Thermal-Hydraulic Test Facility (THTF) and written to an Engineering Units (EU) dataset.

31102 **(PB—81-801177) Shear flow: liquids. 1964-October 1980 (citations from the NTIS Data Base). Report for 1964-October 1980.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Dec 1980. 227p. NTIS PC N01/MF N01.

Shear flow and stresses are studied for a number of liquid forms such as water, lubricants, polymers, liquified gases, and liquid metals. The studies relate to hydrodynamics, elastohydrodynamics, magnetohydrodynamics, fluerics, rheology, acoustics, and oceanology. Some of the subjects include cavitation, jets, mixing, stratification, ultrasonics, capillary flow, blood circulation, sedimentation, wake, injection, liquid-gas interactions, and pipe and channel flow. Other topics cover drops, surface flow, nonnewtonian fluids, liquid crystals, hydraulic fluids, and layers. Theoretical aspects, mathematical models, equations of motion, computer programs, measurement technology, and empirical relationships are included. Materials on the atmosphere are wind shear, as well as drag reduction by polymers which is documented in a separate bibliography, are excluded. (This updated bibliography contains 218 citations, 9 of which are new entries to the previous edition.)

31103 **(PB—81-801185) Shear flow: general studies. 1965-October, 1980 (citations from the NTIS Data Base). Report for 1965-Oct 80.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Dec 1980. 309p. NTIS PC N01/MF N01.

General aspects of fluid shear in laminar and turbulent flow are discussed. Companion bibliographies contain materials on shear flows in specific gases and liquids. The present discussions cover boundary layer dynamics, layers, stratified flow, stresses, ducts, pipes, channels, mixing, bursts, magnetohydrodynamics, viscosity, and oscillation. References are made to separation and reattachment. Wind tunnel modeling and flat plate characteristics are described, including mathematical models, computerized simulation, theory, equations of motion, anemometry, numerical analysis, and stability. Data are given on wall flow, wake, heat transfer, pressure gradients, and similar topics. Wind shear has been excluded. (This updated bibliography contains 300 citations, 15 of which are new entries to the previous edition.)

31104 Efficient numerical solution of the nonlinear inverse heat conduction problem. Beck, J.V.; Litkouhi, B.; St. Clair, C.R. Jr. (Mich State Univ, East Lansing). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-3, 1-7(Jul 1980).

The nonlinear inverse heat conduction problem is the calculation of surface heat fluxes and temperatures utilizing measured interior temperatures in opaque solids possessing temperature-variable thermal properties. The most widely used numerical method for this problem was developed by Beck. The new procedure presented herein reduces the number of computer calculations by a factor of three or four. The general heat conduction model utilized permits treatment of various geometries, energy sources and fin effects. The numerical procedure is illustrated for finite differences but the basic concepts are also applicable to the finite element method. 17 refs.

31105 Heat transfer from internally heated hemispherical pools. Gabor, J.D.; Cassulo, J.C.; Ellison, P.C. (Argonne Natl Lab, Ill). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-16, 1-7(Jul 1980).

Experiments were conducted on heat transfer from internally heated $ZnSO_4$-H_2O pools to the walls of hemispherical containers. This experimental technique provides data for a heat transfer system that has to date been only theoretically treated. Three different sizes of copper hemispherical containers were used: 240, 280, and 320 mm in diameter. The pool container served both as a heat transfer surface and as an electrode. The opposing electrode was a copper disk, 50 mm in diameter located at the top of the pool in the center. The top surface of the pool was open to the atmosphere. 12 refs.

31106 Boiling heat transfer and critical heat flux in helical coils. Jensen, M.K.; Bergles, A.E. (Univ of Wis, Milwaukee). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-49, 1-10(Jul 1980).

Subcooled critical heat flux (CHF) degradation in coils, relative to straight tubes, increases with mass velocity and ratio of tube diameter to coil diameter (d/D). Quality CHF is enhanced and increases with d/D; CHF initially increases with increasing mass velocity but decreases after a maximum is reached. Operational problems can occur if a coiled tube is operated with low subcooling or quality near the inlet and high quality near the exit. 29 refs.

31107 Finite element method for the analysis of heat transfer in composites of highly-conducting and insulating materials. Ahrens, F.W.; Sererciyan, M. (Argonne Natl Lab, Ill). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-106, 1-7(Jul 1980).

A modification of the two-dimensional finite element heat transfer analysis method is presented that is specifically oriented toward the solution of problems involving composite constructions consisting mainly of insulating material, which are given structural rigidity by the use of strong, thin (but highly-conductive) materials. In the proposed method, the large regions of insulating material are covered with two-dimensional elements, but the thin conductors are modeled with one-dimensional elements. The advantages of the method are illustrated by means of an example problem of practical significance. 10 refs.

4205 Materials Testing

REFER ALSO TO CITATION(S) 30473, 30541, 31070, 31075

31108 Eddy current inspection tool. Petrini, R.R.; Van Lue, D.F. (to Dept. of Energy). US Patent Application 201,946. 29 Oct 1980. 18p.

A miniaturized inspection tool, for testing and inspection of metal objects in locations with difficult accessibility, which comprises eddy current sensing equipment with a probe coil, and associated coaxial coil cable, oil energizing means, and circuit means responsive to impedance changes in the coil as effected by induced eddy currents in a test object to produce a data output signal proportional to such changes. The coil and cable are slideably received in the utility channel of the flexible insertion tube of a fiberoptic scope. The scope is provided with light transmitting and receiving fiberoptics for viewing through the flexible tube, and articulation means for articulating the distal end of the tube and permitting close control of coil placement relative to a test object. The eddy current sensing equipment includes a tone generator for generating audible signals responsive to the data output signal. In one selected mode of operation, the tone generator responsive to the output signal above a selected level generates a constant single frequency tone for signalling detection of a discontinuity and, in a second selected mode, generates a tone whose frequency is proportional to the difference between the output signal and a predetermined selected threshold level.

31109 Non-intrusive ultrasonic liquid-in-line detector for small diameter tubes. Piper, T.C. (to Dept. of Energy). US Patent Application 190,303. 24 Sep 1980. 12p.

An arrangement for detecting liquids in a line, using non-intrusive ultrasonic techniques is disclosed. In this arrangement, four piezoelectric crystals are arranged in pairs about a 0.078 inch o.d. pipe. An ultrasonic tone burst is transmitted along the pipe, between crystal pairs, and the amplitude of the received tone burst indicates the absence/presence of liquid in the pipe.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 30647

31110 (UCID—19165) Electronic engineer's design station user's guide. Magnuson, W.G. Jr.; Shectman, R.M.; Hatfield, L.; Willett, G.W.; Loomis, H.H. Jr. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 71p. NTIS, PC A04/MF A01. Order Number DE81023578.

This guide is a description of how the Design Station is used to enter a designer's sketch on the minicomputer-based interactive graphics system. Schematic construction, component placement, output control, and save/restore of designs are all described in detail. The interactive graphics menu options are described and an explanation of their actions is given.

31111 Analytical and numerical studies of foilless diodes. Jones, M.E.; Mostrom, M.A.; Thode, L.E. (Intense Particle Beam Theory Group, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). W-7405-ENG-36. *Journal of Applied Physics ;* **52**: No. 8, 4942-4949(Aug 1981).

The generation of intense annular beams by foilless diodes is studied through analytic equilibrium models and particle-in-cell simulation. In the high-voltage regime, the foilless diode operates below the space-charge limit and the impedance is nearly independent of the voltage. The current density is proportional to the current and to the square of the external magnetic field. From a kinetic theory equilibrium model, the beam scattering angle is found to be inversely proportional to the diode voltage, external magnetic field strength, and cathode radius. The predicted scaling is in good agreement with the simulation results. Criteria for adiabatic expansion and cooling of the beam, supported by simulation results, have also been considered.

31112 Method of controlling switching of a multiphase inductor-converter bridge. Fuja, R.E.; Kustom, R.L. (to Department of Energy). US Patent 4,245,287. 13 Jan 1981. Filed date 28 Feb 1979. vp.

PAT-APPL-016037.

In an inductor-convertor circuit for transferring electrical energy between a storage coil and a load coil using a storage thyristor bridge, a load thyristor bridge, and a set of commutating capacitors, operation is improved by a method of changing the rate of delivery of energy in a given direction. The change in rate corresponds to a predetermined change in phase angle between the load bridge and the storage bridge and comprises changing the phase of the bridge by two steps, each equal to half the predetermined change and occurring 180° apart. The method assures commutation and minimizes imbalances that lead otherwise to overvoltages.

31113 Semiconductor with protective surface coating and method of manufacture thereof. Hansen, W.L.; Haller, E.E. (to Dept. of Energy). US Patent Application 188,436. 19 Sep 1980. 36p.

Passivation of predominantly crystalline semiconductor devices is provided for by a surface coating of sputtered hydrogenated amorphous semiconductor material. Passivation of a radiation detector germanium diode, for example, is realized by sputtering a coating of amorphous germanium onto the etched and quenched diode surface in a low pressure atmosphere of hydrogen and argon. Unlike prior germanium diode semiconductor devices, which must be maintained in vacuum at cryogenic temperatures to avoid deterioration, a diode processed in the described manner may be stored in air at room temperature or otherwise exposed to a variety of environmental conditions. The coating compensates for pre-existing undesirable surface states as well as protecting the semiconductor device against future impregnation with impurities.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 29929, 29930, 30466, 30467, 30468, 30500, 30503, 30504, 30520

31114 (BNL—29303) Portland cement as a regenerable sorbent for the removal and recovery of SO_2 in the fluidized-bed combustion of coal. Steinberg, M.; Yoo, H.J.; McGauley, P.J. (Brookhaven National Lab., Upton, NY (USA)). Mar 1981. Contract AC02-76CH00016. 38p. (CONF-8105106—1). NTIS, PC A03/MF A01. Order Number DE81027304.

From Governor's conference on expanding the use of coal; Albany, NY, USA (21 May 1981).

A sorbent which solves most of the problems for the removal of sulfur in the Fluidized Bed Combustion (FBC) of Coal has been developed. The sorbent is based on the use of calcium silicate which is contained in commercial grade Portland cement. The Portland cement is hydrated and agglomerated in a drum type pelletizer to form particles in the size range required for operating FBC units. These are subsequently cured and dried into hard durable pellets which can be directly used in the FBC. Pellet formation is a low energy process. Laboratory measurements have been obtained on the rate and capacity of absorption of SO_2 using simulated combustion gases. The sulfated cement pellets have also been regenerated to reform the sorbent and produce a concentrated SO_2 gaseous stream. In the overall process, the SO_2 will be reduced to sulfur for disposal or for market use. The cement sorbent has been put through more than 10 cycles of absorption and regeneration with little loss of reactivity. Laboratory attrition studies indicate minimal loss of sorbent (less than 3% per cycle). The sorbent is effective up to a temperature of over 1000°C in FBC, which would significantly improve the overall power production efficiency of the plant. Portland Cement Type III (PC III) sorbent can readily remove 90% of the sulfur from a high sulfur (4%) coal. Thermodynamic and laboratory pressurized TGA tests indicate that PC III will be effective in pressurized fluidized bed combustion (PFBC) units since the sulfation rate is not decreased under higher CO_2 partial pressures compared to limestone. The equilibrium concentration of SO_2 on regeneration of PC III is much higher than for limestone. Another important advantage of Portland cement sorbent is that it is produced under quality controlled conditions and is not subject to the variability of natural deposits of limestone with respect to composition, reactivity and capacity for SO_2 removal.

31115 (DOE/ET/13152—7) Measuring and modeling solids movement in a large, cold fluidized bed test facility. Seventh quarterly report, April 1-June 30, 1981. Fitzgerald, T.J.; Mrazek, R.V.; Crane, S.D. (Oregon State Univ., Corvallis (USA). Dept. of Chemical Engineering). Jun 1981. Contract AC01-79ET13152. 16p. NTIS, PC A02/MF A01. Order Number DE81026283.

Progress in developing improved driving and measuring circuits for a magnetic flow meter for measuring the movement of solids in a cold fluidized bed test facility is reported. Refinements in the amplification circuit resulted in higher gain capability and an extremely low noise-to-signal ratio. A measuring probe containing the new drive circuit coils was tested at varying solid flow rates. The output signal versus magnetic-solids mass flux was nearly linear. An 18 x 18-in fluidized bed which will use this instrumentation has been constructed. (LCL).

31116 (DOE/MC/14110—177) Alexandria Fluidized Bed Process Development Unit cold mode testing. Annual report, March 1980-February 1981. (BENMOL Corp., Alexandria, VA (USA)). 1981. Contract AC21-80MC14110. 48p. NTIS, PC A03/MF A01. Order Number DE81027371.

The objectives of the current test program include validation of predictions from the Massachusetts Institute of Technology Coal AFBC System Model, experimental studies supporting AFBC process development, and the collection of transient data for process control studies. This Annual Report summarizes activities and corresponding results during the period from March 1980 to February 1981. Primary activities included: checkout of the process development unit (PDU); cold mode testing aimed at the collection of fluid mechanics data; initiation of MIT Model validation using cold mode test results; preparations for subsequent hot mode testing; and various support activities. During cold mode testing, sulfated limestone was fluidized with air at temperatures ranging from 80 to 500°F in the 3' x 3' (nominal) size PDU. This report contains a highly condensed summary of cold mode test results. Hot mode operation was limited to training, maintenance, and equipment shakedown tests. MIT Model predictions tested include: slumped bed height, minimum fluidizing velocity, expanded bed height, and gas dispersion coefficient. In all cases, there were large discrepancies between the model predictions and corresponding experimental results. Other results obtained included solids size distribution and particle size profiles in the bed. No transient process data was collected due to hardware problems with the computerized Data Acquisition System. Hot mode testing and validation of the MIT Model will continue in the future. Current plans include tests of heat transfer, combustion efficiency, and sulfur retention. Chemical and physical analysis of solids samples from the Georgetown University Fluidized-Bed Boiler Plant was initiated.

31117 (DOE/METC/RI—188) High-temperature measurements of alkali levels in an experimental 6-inch AFBC. Anderson, R.J.; Grimm, U.; Romanosky, R.R. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Feb 1981. 15p. NTIS, PC A02/MF A01. Order Number DE81023632.

Alkali metals (K and Na) were measured with an on-line atomic emission (AE) spectrometer in the effluent stream of a 6-inch diameter atmospheric fluidized-bed combustor (AFBC). In an effort to simulate the performance of a pressurized fluidized-bed combustor (PFBC), the AFBC was operated at 1650°F and dolomite was used for the bed material. Pittswick coal was burned during the tests. The on-line AE unit monitored a representative fraction of the effluent stream. The sample stream was provided by a specially designed sample system with the inlet port located in the freeboard of the FBC. The sample system was fabricated of Hastalloy X and could be heated up to 1200°F. In order to control the size of particles in the sample stream, the sample system contained a cyclone designed to have a cut-off diameter of 10 μm. Flow through the sample system was regulated by controlling the pressure of the freeboard from 0 to 20 inches of water. In all tests (even when coal was not being burned in the FBC) a ratio of K to Na of about 3 to 1 was observed. This ratio was verified by analysis of aerosol samples for Test 6 (coal and dolomite feed). However, concentrations of alkali as determined by analysis of aerosol samples for Test 6 were about an order of magnitude higher than those measured by the AE unit. Alkali levels (K and Na) on the order of 10 ppM were measured on the sample stream.

4220 Underground Engineering

31118 Design of special performance bits utilizing synthetic diamond cutters. Huff, C.F.; McFall, A.L.; St. Clair, J.A. Dallas, TX; American Institute of Mining, Metallurgical and Petroleum Engineers, Inc. (1978). 10p.

From 53. annual conference and exhibition of the Society of Petroleum Engineers of AIME; Houston, TX, USA (1 Oct 1978).

A new technique (diffusion bonding) for attaching synthetic, polycrystalline diamond cutters to drill bits has been developed by

Sandia Laboratories with funding from the Department of Energy. To test the diffusion bonding technique and some new bit design concepts, Sandia is designing several types of special performance bits utilizing synthetic diamond compacts. Two all-compact bits, a hybrid diamond-compact/roller-cone bit, and two coring bits are being built for testing in laboratory and field environments. A special coring bit designed to operate with a pressure coring system and to be cleaned and cooled with a small quantity of low-invasion coring fluid is undergoing drilling tests. One configuration of the downhole replaceable chain drill utilizes synthetic diamond cutters at the pivot point, while a second configuration utilizes these cutters exclusively. This paper describes the design of each bit and presents the results of recent drilling tests. Design and testing philosophy are reviewed and plans for future design revisions and testing are described.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 30044

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 29896, 29915, 30501

31119 **(PB—81-801284) Air pollution control using particle filtration. 1964-November 1980 (citations from the NTIS Data Base). Report for 1964-November 1980.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Dec 1980. 136p. NTIS PC N01/MF N01.

The citations discuss technology, equipment design and performance, ultrafiltration, and size distribution factors. Aerosol and dust filtration are included. Studies on electrostatic precipitators have been excluded. (This updated bibliography contains 229 citations, 56 of which are new entries to the previous edition.)

31120 **Denitrification of combustion gases.** Yang, R.T. (to Dept. of Energy). US Patent Application 195,543. 9 Oct 1980. 17p.

A method for treating waste combustion gas to remove the nitrogen oxygen gases therefrom is disclosed wherein the waste gas is first contacted with calcium oxide which absorbs and chemically reacts with the nitrogen oxide gases therein at a temperature from about 100° to 430°C. The thus reacted calcium oxide (now calcium nitrate) is then heated at a temperature range between about 430° and 900°C, resulting in regeneration of the calcium oxide and production of the decomposition gas composed of nitrogen and nitrogen oxide gas. The decomposition gases can be recycled to the calcium oxide contacting step to minimize the amount of nitrogen oxide gases in the final product gas.

4250 Power Cycles

REFER ALSO TO CITATION(S) 30078, 30079, 30080, 30081, 30082, 30083, 30084, 30085, 30086

31121 **(EGG-CS—5351) Manual for the program CASLE: cycle analysis and second-law evaluation.** Madsen, W.W.; Bogue, J.L.; McMurtrey, C.D.; Richlen, S.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1981. Contract AC07-76ID01570. 262p. NTIS, PC A12/MF A01. Order Number DE81027487.

This report serves as a user's manual and also describes the computer program CASLE, which models and analyzes Rankine and Brayton cycle systems with regenerator, superheat, and supercritical cycle options. The code has a state point option that will describe any cycle for which the values of pressure and temperature at each state point are known. The code generates the required thermodynamic properties internally using only a few input constants for fluids that are either internal to the code or external to the code. This report also contains an equation summary and equation derivation section as well as code listing and code variable definitions. The program version presented is written in Dartmouth BASIC Language and intended for use with the Tektronix 4052 computer.

43 PARTICLE ACCELERATORS

4302 Beam Dynamics, Field Calculations, And Ion Optics

31122 **Means for the focusing and acceleration of parallel beams of charged particles.** Maschke, A.W. (to Dept. of Energy). US Patent Application 189,990. 23 Sep 1980. 35p.

Apparatus for focusing beams of charged particles comprising planar arrays of electrostatic quadrupoles. The array may be assembled from a single component which comprises a support plate containing uniform rows of poles. Each pole is separated by a hole through the plate designed to pass a beam. Two such plates may be positioned with their poles intermeshed to form a plurality of quadrupoles.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 30075, 31112, 31136, 31253

31123 **(UCRL—53148) Stress calculations for RTNS-II 50-cm targets.** Schumacher, B.J.; House, P.A. (Lawrence Livermore National Lab., CA (USA)). Apr 1981. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01. Order Number DE81028498.

Structural calculations made during design of a 50-cm target for the Rotating Target Neutron Source (RTNS-II) are detailed. The limited ability of the current 23-cm diameter target to dissipate the additional beam power required for a yield increase from 2 x 10^{13} to 4 x 10^{13} neutrons/second has resulted in the need for a larger target. The stresses of several design configurations for a 50-cm target were calculated. The stress contours that would occur in several different target designs with and without various types of structural reinforcement that reduce stress and deflection are presented.

31124 **(UH—511-203-75) EMI coordinate fitting.** Peters, M.W. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Sep 1975. Contract AC03-76ER00511. 25p. NTIS, PC A02/MF A01.

The External Muon Identifier (EMI) developed by the University of Hawaii-Lawrence Berkeley Laboratory collaboration for use with the Fermi National Accelerator Laboratory 15' hydrogen bubble chamber consists of a layer of dense absorbing material followed by a layer of multiwire proportional chambers (MWPC). One algorithm developed for the reduction of the data recorded by the EMI to yield x-y coordinates of particle penetrations through the sensitive plane is described.

31125 **(UCRL-Trans—11696) Nuclear effort in Argentina: the TANDAR project.** Bernaola, O.A. Translated from *Interciencia ;* **6**: No. 2, 93-99(Mar 1981). 23p. NTIS, PC A02/MF A01. Order Number DE81027178.

A complete description of the tandem accelerator facility being built for the Atomic Energy Commission of Argentina is given. Specifications are given for the ion source and injector system, the accelerator, the magnetic analyzer, the pressure tank, the SF_6 handling system, the buildings, the experimentation areas, control room and data collection room. A brief comment is made about experimental programs to be undertaken. (GHT)

4304 Storage Rings

31126 **(DOE/ER/10759—1) construction and maintenance of SUNY facilities at the National Synchrotron Light Source. Progress report, 1 October 1980-30 September 1981.** Bigeleisen, J.; Coppens, P.; Stephens, P. (State Univ. of New York, Albany (USA). Research Foundation). 1981. Contract AC02-80ER10759. 20p. NTIS, PC A02/MF A01. Order Number DE81027855.

The research program for the SUNY group is described, including beamline construction, equipment acquisitions, synchrotron experiments performed by group members, and interaction with the BNL staff. (GHT)

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 30059, 31113, 31124, 31207, 31423

31127 (DOE/ER/10550—2) CCNY collaboration with BNL in R and D for ISABELLE detectors. Technical progress report, November 1, 1980-June 10, 1981. Lindenbaum, S.J. (City Coll., New York (USA)). 1981. Contract AC02-79ER10550. 2p. NTIS, PC A02/MF A01. Order Number DE81027963.

The difference in ionization loss of particles as a function of their velocity is widely used as a technique to identify the particles. The ionization loss in gas samples an order of magnitude smaller than previously investigated was studied. In order to do this, new techniques were developed which use a longitudinal drift ionization detector and fast analog to digital conversion techniques which allow one to effectively slice a piece of track into very small samples by electronic means using a small prototype chamber. It was demonstrated that this technique can substantially improve the mass resolution capability of gas particle detectors, and was shown that only a rather coarse analog to digital converter (ADC) resolution is required to capture all the information needed with the truncated mean sampling method employed to determine the relative energy loss. These new developments can substantially increase the sensitivity of particle separation by ionization measurements via gas particle detectors. A larger ten-layer prototype is now being tested which will optimize the design for a large type of test chamber which could then be utilized to design actual experimental measuring equipment.

31128 (DOE/EV/04733—T1, pp 67-82) **Microdosimetry of ^{125}I and ^{241}Am using a non-metallic wall-less proportional counter.** Kliauga, P.; Rossi, H.H. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

Most of the work on photon spectra has been at energies > 200 keV, and all of the data using proportional counters have made use of counters with steel electrode structures. The presence of stainless steel wires ordinarily used in counter construction may seriously distort the lineal energy spectra of photons having energies of —20 to 100 keV. The distortion results from the fact that the photoelectric cross-section will in this energy region be much higher for the steel structures than for the low-z tissue-equivalent plastic or gas. The higher energy photoelectrons emitted by the steel wires produce a slowing-down spectrum in the vicinity of the collecting volume which is, on the average, too energetic. In order to investigate the magnitude of this distortion, we have constructed an entirely non-metallic wall-less proportional counter, built wholly of low-z materials. This counter is expected to be especially valuable for the accurate microdosimetric specification of ^{125}I and other low energy x-rays. This paper includes measurements on both high and low energy photons, an examination of changes in spectra with depth in tissue for ^{125}I and an interpretation of results. Comparison with previous work using conventional wall-less counters is also included.

31129 (DOE/EV/04733—T1, pp 83-87) **Microdosimetry in the nanometer region.** Biavati, M.H.; Rossi, H.H.; Goldhagen, P. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

Experimental work on the grid avalanche chamber has been continued. Several aspects of problems related to chamber operation, in particular the efficiency, have been investigated. These include a study of background and noise fluctuations with an effort to decrease and stabilize them, an effort to decrease light leaks, and an effort to determine if the light measured by the photomultiplier tube comes from the gas itself or from the scintillator. Work was also done on measuring coincidences between the solid state detector (which registers alpha particle traversals of the chamber) and the photomultiplier tube output, since all of the necessary electronics have finally been obtained. A study of the shape of equipotentials in the detector region was undertaken and also an apparatus was developed to apply thin coatings in a vacuum system.

31130 (DOE/EV/04733—T1, pp 88-101) **Nanodosimetry.** Kliauga, P.J. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

The experiment designed to measure ionization distributions in small volumes simulating tissue regions on the order of nanometers in linear; dimension has been termed nanodosimetry. The fundamental idea in this experiment is to separate the relatively high pressure region (of the order of several Torr) in which ions are formed, called the ion chamber, from the high vacuum region containing a particle detector such as a channeltron (pressures typically —10^{-5} Torr) by a vacuum-tight shutter mechanism. This technique eliminates the need for differential pumping provided that the high vacuum pump speed is sufficient to keep pressures near 10^{-5} Torr with the shutter operating. Ions formed during the shutter opening time are than pulled into the high vacuum detection region through a one-millimeter diameter hole by an applied electric field, and are further accelerated to the channeltron by the potential on the front detecting surface of the channeltron. New hardware has replaced much of the old which has been found to be inadequate. The acquisition of this hardware, often a lengthy procedure in itself, along with the competition of other microdosimetric projects for time has slowed the progress of this nanodosimetry project. However, the major components are now in place and have been tested. Some data have been taken and these preliminary results seem to indicate that the experiment may well be a viable technique for measuring ionization distribution in very small volumes.

31131 (DOE/EV/10402—T1) Positron-ring system using one-dimensional Anger-type detectors. Progress report, July 1, 1980 - July 1, 1981. Muehllehner, G.; Colsher, J.G. (Pennsylvania Univ., Philadelphia (USA)). Jul 1981. Contract AC02-80EV10402. 16p. NTIS, PC A02/MF A01. Order Number DE81027309.

The electronic processor electronics for a high-speed Anger-type scintillation camera was designed. A bar camera consisting of a 2 in. x 2 in. x 20 in. long sodium iodide scintillation crystal and ten photomultipliers was assembled and tested together with the processor electronics. For this purpose, the digital output of the bar camera was interfaced to a microprocessor-controlled memory capable of expansion to a system with as many as six bar cameras in a hexagonal ring. Results achieved so far indicate a spatial resolution of 15 mm FWHM and count rates up to 900,000 counts per second.

31132 (LA—8893-MS) Optics of mass separator I. Balestrini, S.J. (Los Alamos Scientific Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 43p. NTIS, PC A03/MF A01. Order Number DE81028242.

The ion optics of an existing mass separator are documented. The elctrostatic and magnetic stages are analyzed theoretically, both separately and in combination, by paying particular attention to the ion trajectories, the linear and angular magnifications, and the dispersion. The possibility of converting the magnet into a tunable unit by means of current-carrying elements in the gap is demonstrated. The feasibility of correction coils constructed from printed circuit board is shown.

31133 (LA-UR—81-2283) Spectrometric properties of crystals for low-energy x-ray diagnostics. Barrus, D.m.; Blake, R.L.; Felthauser, H.; Fenimore, E.E. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 10p. (CONF-810651—4). NTIS, PC A02/MF A01. Order Number DE81028763.

From 1981 topical conference on low-energy X-ray diagnostics; Livermore, CA, USA (8 Jun 1981).

Quantitative diagnostics of fusion and astrophysical plasmas require knowledge of crystal spectrometric properties. To provide more reliable and versatile diagnostics of plasma conditions, increasingly accurate knowledge of crystal spectrometric properties is becoming necessary. A summary is presented of the following accurately measured parameters for the crystals KAP, RbAP, TlAP, NH_4AP, NaAP, ADP, and EDDT: the interplanar spacing of atoms; the angle correction for normal and anomalous dispersion

that is required for application of the Bragg formula; the thermal expansion coefficient near room temperature for commonly used planes; and the integrated coefficient of reflection.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 31091

31134 (HEDL-SA—2171) Comparative gamma radiation and temperature induced effects in SiO_2, MgO, and Al_2O_3 insulated instrument cables. Cannon, C.P. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1980. Contract AC14-76FF02170. 4p. (CONF-801103—62). NTIS, PC A02/MF A01. Order Number DE81026502.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

The relative errors caused by the effects of gamma radiation and temperature, two unavoidable conditions occurring within the in-vessel environment of a reactor, have been investigated for SiO_2, MgO, and Al_2O_3 insulated instrument cables. The data indicates that SiO_2 insulated cable possesses higher insulation resistance and is less affected by induced background currents under the combined effects of gamma radiation and temperature. Tests conducted both in a test reactor and in a ^{60}Co gamma irradiation facility suggest that the low compaction density of SiO_2 cable minimizes the extraneous effect of gamma radiation on output signals of self powered neutron detectors and other instrument cables.

31135 (LA-UR—81-2135) Radiation-induced transient absorption in optical fibers. Looner, L.D.; Turquet de Beauregard, G.; Lyons, P.B.; Kelly, R.E. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 18p. NTIS, PC A02/MF A01. Order Number DE81028742.

Transient absorption in optical fibers has been studied with emphasis on fast absorption components. Radiation damage was induced with a Febetron 706 electron accelerator, modified to deliver an electron pulse width of 1.1 ns. Dye lasers were synchronized to the accelerator to provide a light pulse through the fiber during the radiation pulse. The output light pulse was detected with a biplanar vacuum photodiode. Four scope traces were used on each electron pulse to monitor the Febetron output, the input drive pulse, and two records of the output pulse on two sweep speeds. Detailed data were acquired for times less than 100 ns after irradiation. An insulated enslosure was used to vary fiber temperature from -30°C to + 250°C. Several fibers were studied with emphasis on ITT T303 PCS fiber. Data were acquired at 600 and 850 nm. Theoretical modeling of the data is presented.

31136 (SAND—81-1578C) Photon-electron correlation in the laboratory testing of electronic components. Part II: beam conditioning and diagnostics. Posey, L.D.; Beezhold, W. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 104p. (CONF-810388—1). NTIS, PC A06/MF A01. Order Number DE81026606.

From AWRE/SNLA/DNA joint conference; Aldermaston, UK (6 Mar 1981).

The work described covers the Sandia National Laboratories (SNL) contributions to an experimental investigation performed jointly with the Defense Nuclear Agency (DNA) and the United Kingdom's Atomic Weapons Research Establishment (AWRE). The objectives of this experimental program were: (1) to determine the limitations (if any) of using electrons to simulate the effects of high dose rate flash x-ray irradiations for TREE studies, (2) to develop and demonstrate the diagnostic testing techniques to allow item (1) to be undertaken, and (3) to demonstrate the use of suitable dosimetry techniques for high total dose/dose-rate irradiations.

31137 (SAND—81-1680C) Effect of gate oxide thickness on the radiation hardness of silicon-gate CMOS. Nordstrom, T.V.; Gibbon, C.F. (Sandia National Labs., Livermore, CA (USA)). 1981. Contract AC04-76DP00789. 24p. (CONF-810707—7). NTIS, PC A02/MF A01. Order Number DE81027202.

From IEEE conference on nuclear science and space radiation; Seattle, WA, USA (21 Jul 1981).

Significant improvements have been made in the radiation hardness of silicon-gate CMOS by reducing the gate oxide thickness. The device studied is an 8-bit arithmetic logic unit designed with Sandia's Expanded Linear Array (ELA) standard cells. Devices with gate oxide thicknesses of 400, 570 (standard), and 700 A were fabricated. Irradiations were done at a dose rate of 2×10^6 rads (Si) per hour. N- and P-channel maximum threshold shifts were reduced by 0.3 and 1.2 volts, respectively, for the thinnest oxide. Approximately, a linear relationship is found for threshold shift versus thickness. The functional radiation hardness of the full integrated circuit was also measured.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 29809, 30044, 30565, 31016, 31030, 31071, 31109, 31115, 31154, 31334, 31351

31138 (DOE/EV/04733—T1, pp 24-28) ^{241}Am irradiator. Zaider, M. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

This report describes an alpha-source irradiator designed and built in this laboratory for the irradiation of cells in culture dishes where the LET distribution of particles traversing the cells should have minimal spread. ^{241}Am was chosen as the best source capable to satisfy these needs. In addition, ^{241}Am is a good compromise between the α energy (5.5 MeV) and its half-life (458 years). The alpha source (plated on a flat surface, 11 x 11 cm) is placed in vacuum. A mylar window separates the vacuum chamber from the irradiated dish. A honeycomb collimator is placed on the source such that the quality of the α energy spectrum is improved. During irradiation the dish is rotated continuously in order to insure uniform exposure over the dish.

31139 (LA—8653) Automated controlled-potential coulometer for plutonium determination. Hollen, R.M.; Jackson, D.D. (Los Alamos Scientific Lab., NM (USA)). May 1981. Contract W-7405-ENG-36. 43p. NTIS, PC A03/MF A01. Order Number DE81028087.

The automated controlled-potential coulometer for the determination of plutonium described in this report is the second in a series of automated instruments designed to determine plutonium and uranium contents in nuclear fuel cycle materials. The measurement precision of the instrument is 0.1% relative standard deviation at the 5-mg plutonium level. A highly selective method of analysis was developed, involving reduction of plutonium to Pu(III) in a 5.5 M hydrochloric acid-0.015 M sulfamic acid electrolyte; oxidation of diverse ions, but not Pu(III); addition of phosphate complexant to reduce the Pu(III)-Pu(IV) potential; and oxidation of Pu(III) to Pu(IV) as the measurement step. Construction details of the mechanical and electrical systems of the instrument and control-system software are described, along with instrument preoperational adjustments and tests and sample analysis operations.

31140 (SAND—81-0727C) Minimum/constant voltage PLZT electrooptic shutters. Harris, J.O. Jr.; Cyrus, J.D.; Laguna, G.R. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 7p. (CONF-810810—19). NTIS, PC A02/MF A01. Order Number DE81028646.

From SPIE international symposium; San Diego, CA, USA (24 Aug 1981).

Lead lanthanum zirconate titanate (PLZT) shutters have been developed and proposed for several military and industrial applications. To achieve electronic simplification in the control circuitry it is desirable to lower the voltage operating level to less than 600 volts, and to minimize logistic problems relating to spare lens inventories it is desirable to produce shutters with a relatively constant operating voltage. Experimental data are presented for a number of electrode gap/PLZT wafer thickness ratios which indicate that this 600 volt maximum can be attained. A procedure is then described whereby manufactured shutters or lens assemblies can be electroded to operate over a narrow voltage range.

31141 (UCRL—85609) Time dependent recording of images transmitted over optical fibers. Lear, R.D. (Lawrence Livermore National Lab., CA (USA)). 24 Aug 1981. Contract W-7405-ENG-48. 14p. (CONF-810810—11). NTIS, PC A02/MF A01. Order Number DE81026599.

From SPIE international symposium; San Diego, CA, USA (24 Aug 1981).

A system is being developed to record temporally and spatially resolved data after transmission through 1 km of optical fiber. Wavelength multiplexing techniques are used to transmit many spatial points over each 62 /sub mu/m fiber. Light from the output end of each fiber is de-multiplexed back into a spatial line. Four lines of data are focused sequentially across the input face of an RCA streak tube. System sensitivity is increased by coupling a microchannel plate image intensifier to the streak camera output. The image intensifier output is recorded on film. The streak camera gives 200 spatial points at a 25% CTF over a dynamic range of 20 db. The total usable streak length is 120 ns with a resolution of 600 ps.

31142 (UCRL—85684) Low energy x-ray spectrometer. Woodruff, W.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Jun 1981. Contract W-7405-ENG-48. 6p. (CONF-810651—3). NTIS, PC A02/MF A01. Order Number DE81025824.

From 1981 topical conference on low-energy X-ray diagnostics; Livermore, CA, USA (8 Jun 1981).

A subkilovolt spectrometer has been produced to permit high-energy-resolution, time-dependent x-ray intensity measurements. The diffracting element is a curved mica (d = 9.95A) crystal. To preclude higher order (n > 1) diffractions, a carbon x-ray mirror that reflects only photons with energies less than ~ 1.1 keV is utilized ahead of the diffracting element. The nominal energy range of interest is 800 to 900 eV. The diffracted photons are detected by a gold-surface photoelectric diode designed to have a very good frequency response, and whose current is recorded on an oscilloscope. A thin, aluminium light barrier is placed between the diffracting crystal and the photoelectric diode detector to keep any uv generated on or scattered by the crystal from illuminating the detector. High spectral energy resolution is provided by many photocathodes between 8- and 50-eV wide placed serially along the diffracted x-ray beam at the detector position. The spectrometer was calibrated for energy and energy dispersion using the Ni $L\alpha_{1,2}$ lines produced in the LLNL IONAC accelerator and in third order using a molybdenum target x-ray tube. For the latter calibration the carbon mirror was replaced by one surfaced with rhodium to raise the cut-off energy to about 3 keV. The carbon mirror reflection dependence on energy was measured using one of our Henke x-ray sources. The curved mica crystal diffraction efficiency was measured on our Low-Energy x-ray (LEX) machine. The spectrometer performs well although some changes in the way the x-ray mirror is held are desirable. 16 figures.

31143 Radiotracer technique for adsorption and catalysis studies: Application to ^{14}C-benzene chemisorption and rehydrogenation on Pt(111). Davis, S.M.; Gordon, B.E.; Press, M.; Somorjai, G.A. (Materials and Molecular Research, and Chemical Biodynamics Divisions, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Vacuum Science and Technology ;* **19**: No. 2, 231-235(Jul 1981).

A radiotracer counting system was developed for adsorption and catalysis studies in ultrahigh vacuum using small area, single crystal surfaces. The counting system utilizes a rugged, compact, and rotatable surface barrier detector with a sensitivity sufficient to detect about 1 x 10^{13} molecules cm^{-2} containing carbon-14. The operating characteristics and performance of this counting system are discussed along with its application to studies of ^{14}C-benzene chemisorption and rehydrogenation on the (111) crystal face of platinum.

31144 Coded aperture imaging with self-supporting uniformly redundant arrays. Fenimore, E.E. (to Dept. of Energy). US Patent Application 191,192. 26 Sep 1980. 20p.

A self-supporting uniformly redundant array pattern for coded aperture imaging. The invention utilizes holes which are an integer times smaller in each direction than holes in conventional URA patterns. A balance correlation function is generated where holes are represented by 1's, nonholes are represented by -1's, and supporting area is represented by 0's. The self-supporting array can be used for low energy applications where substrates would greatly reduce throughput.

31145 Infrared pyrometer for measuring 700-900 kelvin surface temperatures in a combustion gas background environment. Lillquist, R.D. (GE, Schenectady, NY). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-5, 1-8(Jul 1980).

A technique, utilizing infrared radiometry, has been developed for measuring 700-900 K surface temperatures in a pressurized, high temperature combustion gas environment. Intense background radiation from combustion gases hampers measurements of the radiant power flux from low temperature sources. Because gaseous thermal radiation is restricted to certain discrete wavelength bands, background hot gas radiation can be eliminated by simple filtering devices. An investigation into the infrared spectral characteristics of hydrocarbon-air combustion byproduct gases led to the development of a simple radiation pyrometer using an interference bandpass filter, lead selenide detector and sapphire optics. 10 refs.

31146 Sulfur oxide measurements aboard aircraft. Garber, R.W.; Newman, L. Contract AC02-76CH00016. *Atmospheric Technology ;* No. 12, 35-39(1980).

The measurement of atmospheric sulfur oxides has been of importance to analytical chemists for some time, resulting in the development of numerous sampling and measurement techniques. The use of a sampling or measurement technique on an airborne platform places additional and, in some instances, unusual requirements on the methods. A major activity of the Environmental Chemistry Division of Brookhaven National Laboratory (BNL) has been the development of techniques for the measuement of air pollutants such as the oxides of sulfur. We will discuss several measurement techniques for atmospheric sulfur oxides that have been used with some success in airborne studies conducted by BNL and other laboratories.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 29976, 31079

45 EXPLOSIONS AND EXPLOSIVES

REFER ALSO TO CITATION(S) 31075

4501 Chemical

REFER ALSO TO CITATION(S) 31176

31147 (AD-A—091371) Investigation of a high explosive technique for simulation of local fallout from shallow-buried bursts. Final report 1 Mar 1978-31 Jul 1979. Rosenblatt, M.; Kreyenhagen, K.N.; Schuster, S.H.; Schlamp, R.J.; Hassig, P.J. (California Research and Technology, Inc., Woodland Hills (USA)). 1 Nov 1979. Contract DNA001-78-C-0169. 118p. NTIS, PC A06/MF A01.

Detonation of a shallow-buried nuclear device creates a strong shock wave in the surrounding soil, leading to formation of a crater and ejection of soil and radioactive weapon debris into the atmosphere. Predictions of local fallout depositions of this radioactive debris are important in developing tactical doctrines. Currently, predictions of local fallout from low-yield subsurface bursts in wet soils are very uncertain because the relevant nuclear tests were performed in dry alluvial soil at NTS. In this investigation, computer code numerical solutions were performed and analyzed to examine the HE Local Fallout Simulation Technique used in the Diamond Ore and Essex Tests. In this experimental technique, iridium-coated tracer particles are mixed with the HE charge. Three numerical solutions were analyzed: a 10-ton HE burst buried 6 meters in wet soil (i.e., the Essex 6MS test), a 10-ton HE burst buried 6 meters in dry alluvial soil, and a 20-ton nuclear burst buried 6

meters in dry aluvial soil. Comparisons between the solutions indicate important effects on early lofting of tracers or radioactive debris due to differences in wet vs dry soil properties and differences in HE vs nuclear sources. Good agreement was obtained between the HE/Wet Media case and the observed early lofted cloud from Essex Test 6MS.

31148 (MHSMP—81-34) Evaluation of low-chlorine TATB from a production source. Stallings, T.L.; Osborn, A.G.; Johnson, H.D.; Duncan, A.A.; Schaffer, C.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Aug 1981. Contract AC04-76DP00487. 25p. NTIS, PC A02/MF A01. Order Number DE81025474.

Six production lots of low-chlorine TATB powder have been evaluated. Five of the lots were made by a wet-amination process and the other was made by an emulsion-amination process. LX-17 physical properties specimens made from the five wet-aminated TATB lots were exceptionally strong and comparable to dry-aminated TATB, while the emulsion-aminated lot of TATB had lower strength.

31149 (MLM-MU—81-66-0003) Assessment of the MC3608 detonator shipping package hazard classification. Jones, R.B. (Mound Facility, Miamisburg, OH (USA)). 7 Aug 1981. Contract AC04-76DP00053. 38p. NTIS, PC A03/MF A01. Order Number DE81029119.

An investigation was made to determine whether the MC 3608 Detonator should be assigned a DOT hazard classification of Detonating Fuze, Class C Explosive, per 49 CFR 173.113. This study covers the propagation test as approved by DOE-Albuquerque Operations Office. Analysis of the test data led to the recommended hazard classification of Detonating Fuze, Class C Explosive.

31150 (SAND—81-0245C) Review of low-voltage CP detonators. Lieberman, M.L.; Villa, F.J.; Marchi, D.L.; Lause, A.L.; Yates, D.; Fronabarger, J.W. (Sandia National Labs., Albuquerque, NM (USA); Unidynamics, Phoenix, AZ (USA)). 1981. Contract AC04-76DP00789. 25p. (CONF-810926—1). NTIS, PC A02/MF A01. Order Number DE81025837.

From 11. symposium on explosives and pyrotechniques; Philadelphia, PA, USA (15 Sep 1981).

The compound 2-(5-cyanotetrazolato)pentaamminecobalt(III) perchlorate (CP) was developed to provide a relatively safe explosive material for low-voltage, hot-wire detonators. While CP has been committed to a variety of components, information related to the specific detonators has not been previously reported. The many components have gone through various levels of design, development, and production. Consequently, the utilization of CP in DDT devices is regarded as an established technology for our applications. This paper reviews the design and development of CP detonators, and presents data on their performance. This review shows that the explosive CP has been incorporated into a variety of low-voltage deflagration-to-detonation transition (DDT) type detonators. These devices are generally designed to have high density powder in the ignition region for high ignition reliability and low density powder in the DDT region for ease of transition to detonation. The output region has high density powder if output enhancement is desired. Devices have been developed which meet 1 amp/1 watt no-fire and 3.5 amp all-fire requirements with high reliability. Detonation is achieved with high reliability at distances from the bridgewire of $< 1/4$ inch. Output is comparable to other high order detonators. Specific detonators have been fabricated that are small ($< 3/4$" long) and capable of withstanding high shock loads (10,000 g), long-term temperature extremes (-65°C to 80°C), and short-term high-temperature (120°C) excursions. (LCL)

31151 (SAND—81-0246C) Performance of chemical analogs of the explosive CP. Fronabarger, J.W.; Fleming, W.; Lieberman, M.L. (Sandia National Labs., Albuquerque, NM (USA); Unidynamics, Phoenix, AZ (USA)). 1981. Contract AC04-76DP00789. 31p. (CONF-810926—2). NTIS, PC A03/MF A01. Order Number DE81025836.

From 11. symposium on explosives and pyrotechniques; Philadelphia, PA, USA (15 Sep 1981).

The development and weapons systems application of 2-(5-cyanotetrazolato)pentaamminecobalt(III) perchlorate, designated CP, for low voltage detonators, has prompted studies regarding similar compounds in order to arrive at materials superior to CP regarding performance and sensitivity characteristics. Specific desired improvements included shorter deflagration-to-detonation transition (DDT) distances and lower electrostatic discharge (ESD) sensitivity in the confined, pressed state. Pursuant to these goals were synthesis, analytical, and explosive testing activities, which are described. Results of these activities using 12 materials are presented. It is shown that several substituted pentaamminecobalt(III) perchlorates (CP and CP analogs) undergo DDT directly from hot wire ignition. The properties of these materials vary somewhat and show that: some of the CP analogs exhibit DDT tendencies equivalent or superior to CP (e.g., NO_2TzPCP and ClTzPCP); the degree of DDT for the analogs is inversely proportional to density; the larger particle size ICCP has a greater tendency to undergo DDT; none of the analogs studied were ESD sensitive in the bulk or unconfined pressed forms. However, for the confined pressed form, the materials were ignitable from ESD, with sensitivity generally increasing with increased density. Many of the analogs showed lower ESD sensitivity in this form than CP which suggests that safer detonators can be developed through selection of other compounds; the analogs were generally in the same impact sensitivity range as RDX but less sensitive than PETN; and thermal response characteristics of the analogs varied somewhat, with exothermic activities commencing in the range of 250 to 292°C (20°C/min).

31152 (SAND—81-1403) CO_2-laser ignition of DAPP targets. Brannon, P.J. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 56p. NTIS, PC A04/MF A01. Order Number DE81028191.

A pulse derived by shuttering a CO_2 laser operating in the cw mode has been used to ignite a diallyl phthalate pyrotechnic (DAPP) material. Data from this work along with some data taken earlier, while operating the laser in the pulse mode, are presented. When operating in the cw mode, a pulse is mechanically chopped out of the beam and focussed onto the DAPP material. It was found that the shuttered cw mode of operation gives a more reproducible pulse and a more accurate determination of the incident energy than the pulse mode does. The pulse widths for threshold ignition (50% ignitions) at different power levels have been determined for 254 and 127 mm-focal-length lenses which were used to focus the beam on the target. It was also found that targets could be penetrated without ignition of the DAPP material. A 2.54 mm-thick DAPP target is penetrated by the laser beam if the energy per unit area exceeds $29 + 1$ J/mm^2. Based on this study, recommendations are given for improving the present test procedures used for DAPP material.

31153 (UCRL—53163) Degradation of the molecular weight and nitrate ester content of cellulose nitrate on thermal aging. Leider, H.R. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 11p. NTIS, PC A02/MF A01. Order Number DE81029875.

Changes in molecular weight and nitrate ester content for cellulose nitrate (NC), either pure or as a constituent of PBX-9404, were determined as a function of time and temperature. Changes in the number-averaged molecular weight, M/sub n/, are described by the simple theory of random chain scission, and M/sub n/ is found to correlate well with nitrate ester loss. Significant differences are seen between NC aged in the isolated condition and aged as the binder in PBX-9404.

31154 (UCRL—85730-Rev.1) On-board data recorder for hard-target weapons. Niven, W.A.; Jaroska, M.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Mar 1981. Contract W-7405-ENG-48. 14p. (CONF-810367—2(Rev.1)). NTIS, PC A02/MF A01. Order Number DE81028645.

From Fuze section annual meeting (ADPA); San Diego, CA, USA (17 Mar 1981).

The Naval Weapons Center is conducting several hard target penetration weapons development programs. One of the critical problem areas in these programs is the extreme difficulty, due to the hostile nature of the environment, of measuring accelera-

tion-time data from penetration tests. The information is of vital importance in determining design criteria for survivability of components expected to function in such severe environments. This report describes the development of a small, rugged, solid-state on-board recorder to capture dynamic data for testing hard target penetration weapons.

31155 (UCRL—86480) Explosive reaction of cased charges generated by impacts of .30 calibre bullets. Honodel, C.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Jul 1981. Contract W-7405-ENG-48. 22p. (CONF-810837—1). NTIS, PC A02/MF A01. Order Number DE81027558.

From 32. meeting of the Aeroballistic Range Association; Karlsborg, Sweden (12 Aug 1981).

Several high explosive formulations have recently been compared in a series of impact tests where samples of each composition were encased in a test fixture designed in flat geometry mocking an HE loaded artillery projectile. The purpose of the ongoing test series is to determine the relative rate of chemical energy release or explosiveness of several standard and research insensitive high explosive (IHE) main charge compositions. The triggering stimulus is the impact of .30 calibre ball bullets fired at normal muzzle velocity.

4502 Nuclear

REFER ALSO TO CITATION(S) 31147

31156 (AD—337904) Air-blast phenomena as affected by terrain. Swift, L.M.; Sachs, D.C. (Stanford Research Inst., Menlo Park, CA (USA)). 6 Dec 1957. 55p. NTIS PC $7.00.

The objective of Project 1.8c was to obtain data on effects of gross variations of terrain upon a blast wave produced by nuclear explosion, particularly at ground ranges of importance to moderately hard targets. On Shot Smoky (48 kt, 700-foot height of burst), total-head pressure, pitot-tube dynamic pressure, and overpressure were measured: (1) on both sides of a ridge that rose 280 feet to a crest about 2,600 feet from ground zero and (2) at several equivalent ground ranges along relatively smooth terrain. A precursor formed over both flat and ridge blast lines. The wave forms are not pure types and do not lend themselves to definite classification. Surface-level wave-front-propagation velocities indicate enhanced thermal effects on the front slope of the ridge and a strong diffraction effect as the wave passed over the top of the ridge. Generally, the ridge appeared to provide no real protection from overpressure, with increased overpressures noted on the front face and near the bottom of the back slope. However, the ridge appeared to offer considerable protection to drag-sensitive targets along the back slope and at the foot of the back slope. No significant pressure spikes were observed on the ridge line; the precursor-type blast wave probably prohibited this effect.

31157 (AD—338339) Underwater free-field pressures to just beyond target locations. Aronson, C.J.; Bampfield, J.F.; Christian, E.A.; Culling, E.J.; DeVost, V.F. (Naval Ordnance Lab., White Oak, MD (USA)). 27 May 1957. 254p. NTIS, PC A12/MF A01.

Mechanical, piezoelectric, and Wiancko pressure time gages and ball-crusher peak-pressure gages were used to measure the underwater free-field pressures from the deep explosion of an atomic bomb predicted to have the energy of 66 x 10^6 lb of TNT. Gages were located at distances from Surface Zero from about 2000 to 12,000 ft and were suspended at depths down to 2000 ft from buoys, LCM hulls, and YFNB barges. Although many of the gages and records were lost, there was an adequate number of backup systems that provided a wealth of detailed pressure data.

31158 (AD—338541) Air pressures from a deep underwater burst. Merritt, M.L. (Sandia Labs., Albuquerque, NM (USA)). Dec 1955. 25p. NTIS PC $5.00.

Project 4.5 was to study the danger to aircraft from air pressures resulting from a deep underwqater nuclear explosion, and to this end measurements were planned from the surface to a height of 500 ft and out to 6000 ft from surface zero. Bad weather forced abandonment of all but two measurements, surface pressures at 0 to 5500 ft. These data confirm that acoustic coupling can predict peak air pressures at the surface but not later pressures. From Project 4.5 results and data from experiments on high explosives, predictions are made of air pressures to be expected from Wigwam type weapons.

31159 (AD—339905) Basic thermal-radiation measurements. Final report. Hillendahl, R.W.; Laughhridge, F.I. (Northwestern Univ., Evanston, IL (USA). Technological Inst.). 8 Jul 1959. 96p. NTIS, PC A05/MF A01.

Basic thermal-radiation measurements, comprising total and broad-band spectral distribution of radiant energy, radiant energy unction of field of view of the measuring instrument, and total radiant power versus time, are reported for the second thermal pulse of Shots 1, 2, 3, 5, 6, 9, and 10. All data were taken from ground stations at ranges as close as feasible to the detonations. The data are reported and analyzed to obtain the total thermal energy, the total thermal emission per unit of time, fireball sizes and geometries, and color and power temperatures, all as a function of time. New methods of analy sis are used that show promise of correlating the thermal characteristics of the fireball with burst parameters. The new methods result in significantly higher thermal yields in all cases. Significant differences are shown in the thermal properties of tower and air bursts. The air bursts have higher thermal yields, higher peak temperatures, and different pulse shapes than tower bursts. The thermal properties of an air burst are shown to vary with altitude. The higher the altitude, the shorter the time scale, the larger the fireball, and the lower the total thermal energy. The peak temperature is little changed.

31160 (AD—341059) Thermoelastic response of an aluminum box beam. Hovey, W.J. (Dayton Univ., OH (USA)). 12 May 1958. 68p. NTIS, PC A04/MF A01.

To supplement present information on the thermoelastic response of basic aircraft structures, an aluminum box beam instrumented for temperature and strain was exposed during Shot 12 of Operation Teapot. Because blast effects were undesirable, the test specimen was exposed only to the thermal phase by placing it in a blast shield. To increase its absorptance, the front face of the box beam was blackened by anodization. Response data consisted of 18 temperature and 14 strain measurements. Radiant exposure and irradiance were measured behind the glass panel inside the blast shield to permit correlation of box-beam response with thermal input. The maximum temperature rise of the box beam front face was 188 F. This is slightly lower than would have been expected, considering the magnitude of the input and the calculated absorptance of the surface. It has been concluded that either the absorptance calculation was in error or that the absorptance was modified by a slight amount of dust which had settled on the surface. All temperature rises were normal and no anomalies were encountered.

31161 (AD—341060) Missile detonation locator. Miller, M.; Jacoby, D.; Lisman, H.; Pressman, W. (Army Electronics Labs., Fort Monmouth, NJ (USA)). 19 Aug 1957. 116p. NTIS, PC A06/MF A01.

The objective of Project 6.3 was to test the feasibility of a tactical detonation system pres ently under development. The system is designed to locate ground zero by detection and analysis of the electromagnetic radiation emitted during a nuclear detonation. In addition, it is desired that the system furnish information on yield and height of burst.

31162 (AD—355562) In-flight structural response of the model A4D-1 aircraft to a nuclear explosion. Walls, J.H. (Douglas Aircraft Co., Inc., El Segundo, CA (USA)). Jul 1958. 186p. NTIS, PC A09/MF A01.

The objectives of this project were to: (1) measure thermal and blast gust response of the A4D-1 aircraft to nuclear explosion effects, (2) obtain data to improve the methods of predicting blast gust response of aircraft with wings of triangular planform, and (3) correlate experimental response data for the A4D-1 with analytical methods for use in determining its nuclear weapon delivery capability. The gust response results of the tests are presented as wing chord-wise and spanwise pressure distributions versus time, spanwise plots of wing section lift coefficient, average pressure, and

center of pressure versus time, airplane center of gravity and tail acceleration versus time, airplane pitching motion versus time, wing shear, torque, and bending moment versus time, and tail load versus time. Other results of the tests are presented as irradiance and radiant exposure versus time, temperature in thin skin areas versus time, maximum temperature rise at each thermocouple location, peak overpressure, and time of shock arrival. The prediction methods presented in this report for the thermal effects gave fair agreement with the measured results for the radiant exposure and maximum temperature rise.

31163 **(AD—358121) Mine-field clearance by nuclear weapons.** Deeds, F.E.; Fleming, F.W.; Stump, R.K. (Midwest Research Inst., Kansas City, MO (USA)). 16 Aug 1960. 112p. NTIS, PC A06/MF A01.

The objective of the project was to investigate the behavior of pressure-activated antitank mines under air-blast loading from a nuclear detonation. Of particular interest were the reliability of current methods for predicting probability of land-mine actuation from nuclear detonations, the effect of burial depth on mine actuation, and the effect of sympathetic actuation in extending the range of mine clearance. In addition, a study was initiated to determine if special methods were needed for prediction of mine actuation at particular ranges of transition in the pressure-wave shape. Fifteen mine types, both United States and foreign, were employed. Test results indicated: (1) the procedures for predicting mine actuation under nuclear detonations were reasonably accurate; (2) in the live mine fields, sympathetic actuation occurred among mines; (3) the response of the Universal Indicator Mines (UIM) increased with burial depths to a maximum value between 6 and 9 in.; and (4) the reliability of the actuation curves can be improved by laboratory testing of adequate sampling mines.

31164 **(AD—360873) In-flight structural response of an HSS-1 helicopter to a nuclear detonation. Final report.** Walls, J.H.; Heslin, N.C. (Bureau of Naval Weapons, Washington, DC (USA)). 25 Jul 1960. 88p. NTIS, PC A05/MF A01.

An instrumented HSS-1 helicopter was flown in the vicinity of nuclear detonations to measure helicopter response to overpressure and gust and to determine the delivery capabilities of the HSS-1 for antisubmarine warfare as limited by blast effects. Measurements of overpressure and resulting stresses were obtained. Comparisons are shown of experimental gust response data obtained during these HSS-1 tests with prediction of helicopter gust response made possible by employing a six-degrees-of-freedom analysis of helicopter stability and control characteristics and maneuvering loads. Comparison of experimental fuselage stresses with analytical predictions are presented to show the accuracy of the stress analysis methods employed for determination of fuselage response to overpressure. The primary objective of the project was achieved to a certain extent.

31165 **(AD—360874) Structural response and gas dynamics of an airship exposed to a nuclear detonation. Final report.** Gilstad, D.A.; Weeber, C.G.; Kviljord, A.; Woods, G.W. (Bureau of Naval Weapons, Washington, DC (USA)). 25 Apr 1960. 78p. NTIS, PC A05/MF A01.

Four Model ZSG-3 airships, U. S. Navy Bureau of Aeronautics Nos. 40, 46, 77, and 92, participated during Operation Plumbbob to determine the response characteristics of the Model ZSG-3 airship when subjected to a nuclear detonation in order to establish criteria for safe escape distances for airship delivery of antisubmarine warfare special weapons. Restrained response data for 0.40-psi overpressure input were obtained during Shot Franklin with the ZSG-3 No. 77 moored tail to the blast. Unrestrained response data for 0.75-psi overpressure input were obtained during Shot Stokes with the ZSG-3 No. 40 free ballooned, tail to the blast, 300 feet aboveground. The first airship exposed to overpressure experienced a structural failure of the nose cone when it was rammed into the mooring mast, together with a tear of the forward ballonet which necessitated deflation of the envelope. The second airship broke in half and crashed following a circumferential failure of the envelope originating at the bottom of the envelope, forward of the car.

31166 **(AD—361831) Timing and firing.** Warchol, M.F.; Cochrane, D.O. (Edgerton, Germeshausen and Grier, Inc., Boston, MA (USA)). Jul 1955. 61p. NTIS, PC A04/MF A01.

Program V of Joint Task Force Seven was responsible for providing, installing, and operating a radio-controlled timing and firing system. The system was used to supply experimenters with accurate timing signals. The signals were generated by a sequence timer on board the command ship and were transmitted as VHF f-m radio tones which were converted to relay-contact closures by radio-signal receivers at the users' stations. Separate tone generators and transmitters were used for arm, fire, and stop signals, and a triple set of signal receivers at the zero site was suitably interlocked for maximum reliability. Monitoring was provided for power loss at the zero site as well as for the arming and firing functions, position of the arm-clock contacts, presence of salt water in the device, and high voltage on the X-unit.

31167 **(AD—361913) Response of SQUAW targets from high-speed motion pictures of interior.** Atchison, C.M. (David Taylor Model Basin, Washington, DC (USA)). May 1955. 34p. NTIS, PC A03/MF A01.

Twenty-five high-speed cameras, housed in resiliently mounted, pressure-proof containers, were installed in the test compartments of the three SQUAW targets. These cameras recorded the response of the interior of the hulls and simulated propulsion equipment to the loads imposed by the detonation of an atomic device at great depth. The test setup, equipment, and techniques employed are described; results are presented and analyzed. Film records were recovered from SQUAW-29, showing deformations of the hull frames of this surfaced target at a distance of 10,000 ft from the device were less than 0.1 in. Peak displacement between the resiliently mounted simulated engine and its foundation was about 0.7 in. Displacement-time curves of this weight for the initial shock-wave motion and the motion resulting from the bottom-reflected wave were obtained and are presented. Cameras and films aboard SQUAW-12, the target closest to the explosion, were lost when SQUAW-12 sank immediately after the explosion.

31168 **(AD—361914) Vibration characteristics of certain items on SQUAW-29, YFNB-29, and PAPOOSE C.** Paladino, A.R. (David Taylor Model Basin, Washington, DC (USA)). May 1955. 44p. NTIS, PC A03/MF A01.

Resonance and natural frequencies were excited on machinery masses, battery masses, bulkheads, and the hulls of SQUAW-29 and PAPOOSE C and on a diesel generator and an air compressor of Navy barge YFNB-29. The frequencies were excited either by a vibration generator or by striking. In addition to determining many of the frequencies of the items tested, the modes of vibration for some of these are identified.

31169 **(AD—361915) Hull response and shock motion-background, instrumentation, and test results.** Rich, H.L.; Habib, E.T.; Bort, R.L.; Weinberger, F. (David Taylor Model Basin, Washington, DC (USA)). Apr 1957. 90p. NTIS, PC A05/MF A01.

This report presents the background, instrumentation, and test results obtained by Project 3.2. Altogether, 140 velocity meters, 12 accelerometers, 132 shock-spectrum recorders, and 72 mechanical displacement gauges were installed on three SQUAWs and three YFNB's for the measurement of hull response and shock motions. The oscillograph data from the electromechanical pickups were recorded automatically at remote recording stations. Data obtained from all targets are presented.

31170 **(AD—361916) Lethal range of Wigwam targets based on hull response and applied pressure measurements.** Chertock, G.; Hirsch, A.E.; Mayo, R.W.; Ogilvie, T.F. (David Taylor Model Basin, Washington, DC (USA)). Jun 1956. 90p. NTIS, PC A05/MF A01.

The external pressures applied to the three SQUAW targets in Operation Wigwam were measured with pressure gages, and the deformations of the hull were measured with strain and displacement gages. The results indicate that SQUAW-12 was at a horizontal range of 5150 ft and a depth of 290 ft; the peak shock pressure at the hull was about 850 psi and the target destroyed, probably

within 10 msec. SQUAW-13 was at a horizontal range of 7200 ft and a depth of 260 ft; the peak dynamic pressure at the hull was about 615 psi, and the hull was probably near collapse but did not rupture. The estimation is that the lethal horizontal range of the SQUAW target under the Wigwam test conditions is about 7000 ft for a depth of 250 ft and about 4500 ft for a depth of 70 ft.

31171 **(AD—361919) Close-in time of arrival of underwater shock wave.** Porzel, F.B. (IIT Research Inst., Chicago, IL (USA)). 28 May 1957. 114p. NTIS, PC A06/MF A01.

The close-in time of arrival of the shock wave from an underwater nuclear explosion on Operation Wigwam has been measured with good agreement between duplicate systems of electrical switches activated by shock pressure. The measurements extend from a distance of 15 to 2000 ft from the bomb, over a velocity range from approximately 130,000 ft/sec down to acoustic velocities such as 5000 ft/sec. Based on these measurements, the corresponding pressure-distance curve covers a range of 10 to the 5th power-fold from approximately 100 million psi down to 3000 psi. These data have been used to calculate the peak hydrodynamic variables at the shock front, and these calculations in turn permit a fairly complete description of the hydrodynamic variables on the interior of the wave. The weapon yield was calculated to be 31.7 = 1.2 kt.

31172 **(AD—361920) Depth, trim, heading, and flooding of Wigwam targets.** Converse, R.E. Jr. (David Taylor Model Basin, Washington, DC (USA)). May 1955. 30p. NTIS, PC A03/MF A01.

A primary purpose of Operation Wigwam was to determine the effect the detonation of an atomic device at great depth would have on three submarine targets, called 'SQUAWS,' submerged to the same depth but at different distances from the device. In an attack on a submarine with an atomic device, as well as in an attack with a conventional weapon, the magnitude and character of the shock motions in the ship are functions of its depth and position relative to the device. The location and orientation of the SQUAW targets relative to the device would have to be known in order to evaluate fully the responses of the targets. Knowledge of the depth and orientation of each SQUAW was also required to guide in submergence and remote control of each target. A project was set up to measure and record the depth, angle of roll, angle of pitch, and heading of each SQUAW target.

31173 **(AD—362112) Effects of nuclear explosions on fighter aircraft components.** Whitford, D.H. (Dayton Univ., OH (USA)). 28 Feb 1958. 94p. NTIS, PC A05/MF A01.

Six F-80 and 3 F-86D aircraft horizontal stabilizer assemblies were exposed on the ground during Shot 12 of Operation Teapot to investigate stabilizer response to gust loads in the analysis of lethal volumes of nuclear weapons employed to defend against enemy aircraft. Each stabilizer was mounted vertically and oriented at an angle of attack near, but below, the stalling point at 5 different ranges such that the stabilizer nearest and farthest from ground zero would be, respectively, completely failed and essentially undamaged. Post-shot examinations revealed that the F-80 stabilizers at the first 2 ranges were severed near the root, as expected; the damage received by the F-80 stabilizers at the last 2 ranges was about 50% greater than predicted. As damage varied from completely demolished to barely failed, a sufficient range of data for F-80 stabilizer load versus response was obtained. None of the 3 F-86D stabilizers were subjected to failure loads, and the only structural damage consisted of rib buckling near the predicted failure station.

31174 **(AD—363620) Radiological safety.** Maynard, R.H.; Servis, J.D. (Los Alamos Scientific Lab., NM (USA)). Jan 1953. 103p. NTIS, PC A06/MF A01.

This report contains a narrative description of the activities of Task Unit 7 (TU 7), the Radiological Safety (Rad-Safe) Unit of Task Group 132.1, during Operation Ivy. Chapters are devoted to the general discussion of the organization and activities of the scientific sections necessary to implement an atomic-test radiological-safety organization. The appendices contain specific details of operational procedures. Since radiological safety is a technical service and not a specific scientific program, objectives, procedures, and major results cannot be presented in abstract form other than to say that no serious radiation exposures occurred as a result of Operation Ivy.

31175 **(AD—369966) Effects on materials exposed to a nuclear detonation.** Dolen, W.K.; Jefferson, R.M.; Karnowsky, M.M. (Sandia Labs., Albuquerque, NM (USA)). 26 Mar 1965. 142p. NTIS, PC A07/MF A01.

In September 1957, the Fizeau Shot of Operation Plumbbob conducted in Nevada provided an 11-kiloton nuclear burst for a variety of noninstrumented tests upon a broad range of materials related to weapon construction. The objectives were: (1) correlation of structural changes on materials, with respect to fireball location and/or heating rates; (2) observation of the effects on various materials, of thermal and nuclear radiation delivered at high rates, both singly and in combination. Results of this event and its experiments indicate several things. There was a high degree of sample survival, bearing out the general acceptability of sample mounting methods. The fireball studies resulted in the determination of environments independent of measuring systems but closely agreeing with other observed data. Studies conducted outside the fireball showed at best only threshold damage levels.

31176 **(AD-A—091505) Two-dimensional FCT model of low-altitude nuclear effects. Annual report 1 Jun 79-1 Jun 80.** Book, D.L. (Naval Research Lab., Washington, DC (USA)). 16 Oct 1980. 46p. NTIS, PC A03/MF A01.

Low-yield experiments with chemical explosives detonated at low altitude have revealed unusual Mach stem structures. Existing codes employed to simulate these phenomena have been unable to resolve them satisfactorily. During the year beginning 1 June 1979, personnel of the Laboratory for Computational Physics have been working under a contract with the Defense Nuclear Agency to develop software for performing these calculations. For this purpose, we have employed the method of Flux-Corrected Transport (FCT), developed at the Naval Research Laboratory by J. P. Boris and D. L. Book.

31177 **(AD-A—091509) A near-surface burst EMP driver package for prompt gamma-induced sources. Technical report.** Wyatt, W.T. Jr. (Harry Diamond Labs., Washington, DC (USA)). Sep 1980. 50p. NTIS, PC A03/MF A01.

This report summarizes the development of software package specifying electromagnetic pulse (EMP) drivers produced by prompt gamma rays emitted by a near-surface nuclear burst in the air. The package is designed for use with the NEMP EMP prediction computer code. This report describes improved calculations of EMP drivers arising from a point gamma source in air over ground, based on Monte Carlo simulation of the gamma transport by the specially developed SLEDGE computer code. This simulation was done for seven source gamma energies from 0.5 to 7.0 MeV. The transport was carried to a range of 25 mean free paths. Correlated sampling was used to estimate Compton electron currents more accurately. The theoretical basis of the SLEDGE code is discussed. Analytic approximations to the Monte Carlo results are described in detail, including (1) the energy deposition buildup factor (both free field and ground influenced), (2) time dependence of energy deposition as a function of both range from the burst and nearness to the ground, (3) ratio of radial Compton electron current to energy deposition rate, and (4) theta Compton electron current due to the presence of the ground. Comparisons are made with two previous EMP driver packages, with good agreement for cases where the previous packages are believed reliable.

31178 **(AD-A—091806) An analysis of the characteristics of Rayleigh waves produced by surface explosions. Final report, 5 July 1977-31 January 1979.** Murphy, J.R. (Serendipity, Inc., Sherman Oaks, CA (USA)). 31 Jan 1979. Contract DNA001-77-C-0272. 28p. NTIS, PC A03/MF A01.

The successful deployment of an MX missile system requires a careful consideration of ground shock effects which were of secondary importance in previous applications. For example, with the system sited in a valley and under a multiple attack scenario, untargeted points can be expected to experience a significant ground motion environment as a result of the superposition of motions originating from attacks on a variety of surrounding aimpoints. Fur-

thermore, reflections of outgoing energy from the valley boundaries can be expected to complicate the ground motion environment within the valley, particularly at late times. The objective of the work described in this report has been to develop a better quantitative understanding of these late-time, long-period ground motions in order to provide a firmer basis for scaling to new geologic conditions. Particular emphasis has been placed on the identification of the characteristic mode of propagation associated with these arrivals. A theoretical model is described which has been used to compute the surface waves produced by a propagating airblast load acting on the surface of a multilayered, elastic half-space. This model was then applied to the analyses of both the observed data and finite difference simulations of the Pre-Mine Throw and Pre-Dice Throw 100 tone HE surface blasts. In addition, a preliminary assessment has been made of the influence of valley boundaries on the late-time ground motion environment within the valley.

31179 (LA-UR—81-2137) Fiber optic quality assurance at the Nevada Test Site. Manning, J.; Baumgart, S.; Malone, R.; Thayer, D. (Los Alamos National Lab., NM (USA); EG and G, Inc., Los Alamos, NM (USA)). 1981. Contract W-7405-ENG-36. 5p. (CONF-810810—15). NTIS, PC A02/MF A01. Order Number DE81028740.

From SPIE international symposium; San Diego, CA, USA (24 Aug 1981).

A large number of fiber optic cables were used in support of a neutron imaging experiment at the Nevada Test Site. This paper describes the quality control testing of fiber components used on this experiment. The principal reason for quality control testing was to ensure reliable, high transmission fibers; a secondary reason was to gain data on a large sample of fiber cables in the field. Also described is the instrumentation developed for carrying out these field measurements. The design of the quality control instrumentation was a compromise between accuracy and simplicity of use.

31180 (DOE/SF/00115—T7) Spalling of the Earth's surface by underground nuclear explosions. Eisler, J.D.; Chilton, F. (Stanford Research Inst., Menlo Park, CA (USA); Stanford Univ., Palo Alto, CA (USA)). [nd]. Contract AM03-76SF00115. 28p. NTIS, PC A03/MF A01. Order Number DE81026141.

Spalling of the near-surface earth layers caused by contained underground shots detonated in tuff, granite, halite, and alluvium was investigated. From the arrival time data obtained from surface accelerometers, certain aspects of the kinematics of spalling were deduced using simple ballistic and plastic-diaphragm concepts. It was shown that the shape of the spall gap is conical with sides concave upward (the shape of a coolie hat) and not a dome as is commonly supposed. From the arrival time data it was possible to estimate the radial extent of the spall and to compute the thickness of the spalled layer at ground zero. The maximum width of the spall gap at ground zero was smaller than the surface displacement at that point, indicating the existence of additional spall gaps at other depths and perhaps fluffing of the surface formation under the action of spalling forces.

4503 Explosion Detection

31181 (AD-A—091107) Seismic discrimination. Semiannual technical sumMary report 1 Oct 1979-31 Mar 1980. Chinnery, M.A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 31 Mar 1980. Contract F19628-80-C-0002,. 68p. NTIS, PC A04/MF A01.

This report describes 19 investigations in the field of seismic discrimination. The contributions are grouped as follows: 6 describe progress in the development of a Seismic Data Center; 3 describe research into seismic algorithms that will be implemented at the Data Center; 7 are concerned with the problem of source characterization using the seismic moment-tensor formulation; and 3 describe recent improvements in our in-house computer systems.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

31182 (ORNL—5798) Publications in biomedical and environmental sciences programs, 1980. Pfuderer, H.A.; Moody, J.B. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 264p. NTIS, PC A12/MF A01. Order Number DE81028026.

This bibliography contains 690 references to articles in journals, books, and reports published in the subject area of biomedical and environmental sciences during 1980. There are 529 references to articles published in journals and books and 161 references to reports. Staff members in the Biomedical and Environmental Sciences divisions have other publications not included in this bibliography; for example, theses, book reviews, abstracts published in journals or symposia proceedings, pending journal publications and reports such as monthly and bimonthly progress reports, contractor reports, and reports for internal distribution. This document is sorted by the division, and then alphabetically by author. The sorting by divisions separates the references by subject area in a simple way. The divisions represented in the order that they appear in the bibliography are Analytical Chemistry, Biology, Chemical Technology, Information R & D, Health and Safety Research, Energy, Environmental Sciences, and Computer Sciences.

31183 Sensitivities of radiative-convective climate models. Chylek, P.; Kiehl, J.T. (Atmospheric Science Section, Department of Physics, Tufts University, Medford, Massachusetts 02155). DE-AC02-80ER10691. *Journal of the Atmospheric Sciences ;* **38**: No. 5, 1105-1114(May 1981).

We have compared sensitivities of four different radiative-convective climate models. Although surface temperature sensitivities with respect to changes in solar constant and atmospheric, CO_2 concentration are almost the same in all models, sensitivity with respect to some other climate variables varies up to a factor of 2. We have found that the surface temperature sensitivity with respect to changes of the lapse rate is high in all models, and we emphasize the importance of a lapse rate—surface temperature feedback.

31184 Analytical solution for three-dimensional stationary flows in the atmospheric boundary layer over terrain. Kao, S.S. (Department of Meteorology, University of Utah, Salt Lake City 84112). DE-AS02-76EV02455. *Journal of Applied Meteorology ;* **20**: No. 4, 386-390(Apr 1981).

An analytical solution to the Navier-Stokes equations for three-dimensional stationary flows of small Reynolds number in the atmospheric boundary layer over terrain is presented.

5001 Basic Studies

REFER ALSO TO CITATION(S) 31193

31185 (DOE/EV/12195—40) Experimental short-term climate forecasting procedure for US winter temperatures and its verification. Navato, A.R. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Meteorology). 1981. Contract AS02-76EV12195. 4p. NTIS, PC A02/MF A01. Order Number DE81027103.

A linear multivariate regression model for continental United States Januray surface air temperatures is presented. The predictors enter the regression equation at more than one lag if their effects on the predictand tend to be spread over several months rather than be completed in one month. The monthly mean surface tempertures for 12 cities were taken to be representative of temperatures for the regions around them. The predictand series then consisted of annual January values for each representative city. A separate regression equation was derived for the annual departures from the long term means for January for each city. The procedure therefore predicts the inter-annual variability for January. The regression equations for inter-annual variability were able to explain a much higher percentage of variance compared to the corresponding regression equations for monthly variability. The same procedure can be applied to obtain prediction equations for other months. The higher percentage is to be expected if it is considered that there

must be differences in the operation of temperature-controlling physical mechanisms which are dependent on the march of the seasons.

31186 (LA-UR—81-2380) Spectra over complex terrain. Panofsky, H.A.; Larko, D.; Lipschutz, R.; Stone, G. (Los Alamos National Lab., NM (USA); Pennsylvania State Univ., University Park (USA). Dept. of Meteorology; Research and Data Systems, Lanham, MD (USA); National Oceanic and Atmospheric Administration, Boulder, CO (USA)). 1981. Contract W-7405-ENG-36. 18p. (CONF-810742—1). NTIS, PC A02/MF A01. Order Number DE81028734.

From 4. U.S. national conference on wind engineering research; Seattle, WA, USA (26 Jul 1981).

Spectra have been measured over land downwind of a water surface, over hilltops and escarpments, and over rolling farmland. The following hypotheses can be used to explain the differences between these spectra. (1) For wavelengths short compared to the fetch over the new terrain, spectral densities are in equilibrium with the new terrain. (2) For wavelengths long compared to this fetch, spectral densities remain unchanged if the ground is horizontal. If the flow is over a steep hill, the low-frequency structure is modified by distortion of the mean flow, with the longitudinal component losing energy relative to the lateral and vertical components. Because vertical-velocity spectra contain relatively less low-frequency energy than horizontal-velocity spectra, energetic vertical-velocity fluctuations tend to be in equilibrium with local terrain.

31187 (ORAU/IEA—81-7(M)) Inland aquatic ecosystems and the perturbed global-carbon cycle. Mulholland, P.J. (Oak Ridge Associated Universities, Inc., TN (USA)). Aug 1981. Contract AC05-76OR00033. 58p. NTIS, PC A04/MF A01. Order Number DE81028177.

The role of inland aquatic ecosystems in the global carbon cycle is significant, although small compared to that of terrestrial systems and the oceans. Plants in inland waters fix about 0.5×10^{15} gC yr^{-1} worldwide, compared to the 26×10^{15} gC yr^{-1} fixed in the oceans. However, a larger fraction of the carbon fixed in inland aquatic ecosystems is preserved in organic form in sediments as a result of relatively shallow depths, low dissolved oxygen levels in bottom waters, high production rates per unit area, and high rates of total sedimentation in many inland waters. In addition, inland aquatic ecosystems receive inputs of organic carbon from terrestrial ecosystems. Estimates of the contribution of inland aquatic ecosystems to the budget of the perturbed global carbon cycle are summarized. It is concluded that rivers, lakes, and reservoirs may be responsible for recent increases in carbon accumulation in inland sediments and the ocean of about 0.6×10^{15} to 0.8×10^{15} gC yr^{-1}, a small but not insignificant portion of the 0.5 to 4.5×10^{15} g yr^{-1} of carbon missing in budget estimates of the perturbed global carbon cycle. However, the most important issue linking inland aquatic ecosystems and global carbon dynamics may be the impact of CO_2-induced regional changes in temperature and precipitation on the ecological character of inland aquatic systems, water quality and availability, and estuarine productivity.

31188 Mortality, migration, income and air pollution: a comparative study. Bozzo, S.R.; Novak, K.M.; Galdos, F.; Hakoopian, K.; Hamilton, L.D. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Social Science and Medicine, [Part D] Medical Geography ;* **13**: No. 2, 95-109(1979).

The interrelationships among different demographic factors, specific causes of death, median family income, and estimated air pollution emissions were examined. Using the Medical Data Base (MEDABA) developed at Brookhaven National Laboratory, the entire population of the United States was cross-tabulated by income and emission levels of air pollutants. Path analysis was used to examine a number of patterns and relationships for each age, race, and sex group containing a minimum of 10,000 persons. Competitive and complementary effects were observed. These effects were frequently age dependent and occasionally sex related. This specialized data base, the application of path analysis, and the development of a dynamic population and mortality model, in combination, proved to be a useful tool for investigating the effects of energy related pollutants on the exposed population.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 30110, 31146, 31174, 31200

31189 (AD-A—091005) Impact of aircraft emissions on air quality in the vicinity of airports. Volume II. An updated model assessment of aircraft generated air pollution at LAX, JFK, and ORD. Final report Jan 1978-Jul 1980. Yamartino, R.J.; Smith, D.G.; Bremer, S.A.; Heinold, D.; Lamich, D. (Argonne National Lab., IL (USA)). Jul 1980. Contract DOT-FA77WAI-736. 89p. NTIS, PC A05/MF A01.

This report documents the results of the Federal Aviation Administration (FAA)/Environmental Protection Agency (EPA) air quality study which has been conducted to assess the impact of aircraft emissions of carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NOx) in the vicinity of airports. This assessment includes the results of recent modeling and monitoring efforts at Washington National (DCA), Los Angeles International (LAX), Dulles International (IAD), and Lakeland, Florida airports and an updated modeling of aircraft generated pollution at LAX, John F. Kennedy (JFK) and Chicago O'Hare (ORD) airports. The Airport Vicinity Air Pollution (AVAP) model which was designed for use at civil airports was used in this assessment. In addition the results of the application of the military version of the AVAP model the Air Quality Assessment Model (AQAM), are summarized. Both the results of the pollution monitoring analyses in Volume I and the modeling studies in Volume II suggest that: maximum hourly average CO concentrations from aircraft are unlikely to exceed 5 parts per million (ppm) in areas of public exposure and are thus small in comparison to the National Ambient Air Quality Standard of 35 ppm; maximum hourly HC concentrations from aircraft can exceed 0.25 ppm over an area several times the size of the airport; and annual average NO2 concentrations from aircraft are estimated to contribute only 10 to 20 percent of the NAAQS limit level.

31190 (BNL—29855) Concentration and deposition of sulfur oxides in the northeastern United States: a comparison of Airsox model results with monitoring data for July 1978. Kleinman, L.I. (Brookhaven National Lab., Upton, NY (USA)). Apr 1981. Contract AC02-76CH00016. 33p. NTIS, PC A03/MF A01. Order Number DE81028328.

Atmospheric concentrations of sulfur dioxide and sulfate and wet deposition of total sulfur have been calculated for July 1978 in the eastern US and adjoining Canadian areas using the long-range transport model, AIRSOX (Atmospheric Impact of Residual Sulfur Oxide). Air concentrations have been compared with the observed values of SO_2 and SO_4 at stations of the SURE (Sulfate Regional Experiment in the Northeastern US) network. Wet deposition of sulfur has been compared with measurements made at the MAP3S (Multistate Atmospheric Power Production Pollution Study) precipitation chemistry stations. The averaging period of the calculation encompasses the atmospheric residence time of pollutants emitted between July 1 and July 26, 1978. Observations have been averaged between July 6 and July 31, 1978, as this time span approximates the period of impact of the emissions. This study was initiated as part of a MAP3S program in which modelers at Argonne National Laboratory, Brookhaven National Laboratory (BNL), and Pacific Northwest Laboratory performed similar air and deposition quality calculations. A common data base consisting of emissions, upper air winds and temperatures, precipitation, ambient SO_2 and SO_4 concentrations, and precipitation composition was made available at the three laboratories participating in the model comparison. The manner in which the data were used was left to each modeler's judgment. Standardized plotting and statistical routines were made available to each modeling group. The manner in which the data were presented and analyzed was, except for certain guidelines, also left to each modeler's discretion. The model comparison was undertaken to assess the progress that has been made in long-range transport calculations under the MAP3S program.

31191 (DOE/EV/10405—T1) Determination of sulfur speciation in industrial aerosols in an SO_2-rich environment. Progress report, June 1, 1980-July 15, 1981. Eatough, D.J. (Brigham Young Univ., Provo, UT (USA). Thermochemical Inst.). 30 Jul 1981. Contract AC02-80EV10405. 48p. NTIS, PC A03/MF A01. Order Number DE81029026.

The major conclusions of this study are: inorganic and organic S(IV) compounds are generally not present in primary emissions from coal or oil fired plants but are formed in the plumes emitted by these facilities; the formation of sulfate from $SO_2(g)$ in the daytime follows kinetics which are first order in $SO_2(g)$ and are temperature dependent; organic S(IV) compounds are formed in the plumes of the coal and oil fired power plants by a process which is first order in $SO_2(g)$. The k_1 value for this formation reaction may be inversely related to absolute atmospheric humidity. The results obtained suggest that the maximum rate for this reaction in plumes may be about 3% SO_2 hr^{-1}; dimethyl and/or monomethyl sulfate have been shown to be present in both flue line and plume samples from coal and oil fired power plants; methylated sulfates are formed during plume transport in the plumes of the power plants studied. The data are adequately described by a process which is first order in $SO_2(g)$; the use of calorimetry, ion chromatography, colorimetry, proton induced x-ray emission analysis and (where applicable) capillary or packed column gas chromatography-mass spectroscopy to analyze for sulfate, sulfuric acid, inorganic-S(IV), organic S(IV) and methylated sulfates in collected particulate samples has been studied. It has been shown that artifact problems exist in these techniques which must be considered in doing detailed chemical characterization of the sulfur compounds produced by the combustion of fossil fuels; and the chemical structure of the organic S(IV) compound has been tentatively established. Results obtained to date indicate that the organic S(IV) found in plume particulate matter resulting from the combustion of coal or oil is a cyclic sulfite formed by reaction of $SO_2(g)$ and ethylene ozonide.

31192 **(SRIA—115-PA-83-X1) Lidar observations of the lower tropospheric aerosol structure during BOMEX. Final report.** Uthe, E.E.; Johnson, W.B. (Stanford Research Inst., Menlo Park, CA (USA)). Jan 1971. Contract AM03-76SF00115. 128p. NTIS, PC A07/MF A01. Order Number DE81026900.

A lidar (laser radar) was flown on a US Air Force WC-130B aircraft over the BOMEX (Barbados Oceanographic and Meteorological Experiment) area during the third experimental period (20 June to 3 July 1969). The instrument used a neodymium laser (1.06 μm wavelength) and had a firing rate of approximately one pulse per 3.5 seconds. A total of 5192 lidar signatures were collected during the eight flight missions. A computer technique is described that adjusts and corrects the data for the range effect, instrumentation nonlinearities, and pulse-to-pulse variations in transmitted energy, and then objectively performs a contour analysis of the resulting data matrix. Vertical cross sections of normalized lidar signal return obtained in this way are presented along with the associated average vertical profiles. These lidar results are interpreted qualitatively in terms of changes in aerosol density and/or particle size in the lowest 3000 m of the atmosphere. They are compared with vertical profiles of temperature, dew point, and the radionuclides ^{7}Be and ^{95}Zr, which were obtained from supplementary data sources. The data analyzed clearly reveal the existence of well-defined scattering layers associated with the sub-cloud layer, the trade-wind inversion, and the Sahara dust stream. The height, thickness, density and structure of the Sahara dust layer showed large vertical and horizontal variability. The average aerosol scale height determined from this study was 1.48 km (standard deviation of 0.7 km). Lidar returns favorably compare with signatures synthesized by using measured particle size distributions and the Mie theory.

31193 **(TVA/ONR/ARP—81/8) Occurrence of anthropogenic fog and ice from Widows Creek Unit 8 wet scrubber.** Coleman, J.H.; Fagen, L.C. (Tennessee Valley Authority, Muscle Shoals, AL (USA)). May 1981. 42p. NTIS, PC A03/MF A01.

This report describes the results of a modeling study of the effect of the Widows Creek Steam Plant Unit 8 scrubbed plume upon ambient ice and fog formation within 20 km of the plant. The effect of the scrubber on reducing ambient SO_2 near the plant is also investigated. All investigations are repeated for three levels of scrubber reheat: high, medium, and low. The level of plume reheat determines the final height of the scrubbed plume and strongly affects the concentration of water vapor at ground level. Thus, the level of plume reheat is strongly reflected in levels of anthropogenic fog and sulfur dioxide (SO_2) (i.e., environmental impact is always predicted to be greater at a low reheat level than at a high reheat level). Very little impact of anthropogenic ice is predicted under any reheat level. At the worst case (lowest reheat), only 2 percent of the area around the Widows Creek Steam Plant is predicted to be impacted once per year and none of the area is predicted to be impacted twice or more. Anthropogenic fog is predicted to have a low impact over a large area (55 percent of the area at one occurrence of fog per year, low reheat) and to have a higher impact over a small area (10 percent of the area at 10 occurrences of fog per year, low reheat). It is assumed the scrubber removed 88 percent of the SO_2 in the plume. Because of reduced plume rise, however, ambient SO_2 concentrations are often not reduced by 88 percent. Under low reheat, for example, nearly 25 percent of the area near Widows Creek Steam Plant is predicted to experience a reduction in annual averaged SO_2 concentrations of less than 75 percent. Under medium reheat, however, this area of impact is reduced from 25 percent to less than 2 percent.

31194 **(TVA/ONR/ARP—81/9) Data summary: TVA ambient air quality monitoring system calendar year 1980.** Lindsey, R.L. (Tennessee Valley Authority, Muscle Shoals, AL (USA)). Jun 1981. 28p. NTIS, PC A03/MF A01.

This report presents the Tennessee Valley Authority's ambient air quality monitoring activities for the calendar year 1980. Included are the types and number of the pollutant parameters measured; the location of stations in individual coal-fired power plant networks, trend stations, and other monitoring sites; a brief description of the monitoring methodologies employed to measure these parameters; and a summary presentation of the data collected throughout the Tennessee Valley.

31195 **(UCID—19158) Physical and chemical characterization of fine particles in off-gases from coal combustion and oil shale retorting.** Ondov, J.M. (Lawrence Livermore National Lab., CA (USA)). Aug 1981. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01. Order Number DE81026540.

Accompanying the extraction of energy by virtually all of our fossil technologies are by-product aerosols containing toxic and carcinogenic substances on particles of respirable size. Concern for the atmospheric release and effects on human health resulting from subsequent inhalation of these particulate substances has fostered extensive research into process and control technology, atmospheric physics and chemistry, and inhalation toxicology. We studied the physical and chemical properties of process aerosols from coal and oil facilities. The purpose of this work is to develop the source terms of toxic substances for human inhalation dosimetry and to elucidate mechanisms of particles formation and chemical enrichment. Some of the chemical and physical aerosol measurements undertaken in this work are discussed.

5003 Radioactive Materials Monitoring And Transport

31196 **(DPSPU—79-302) Environmental monitoring at the Savannah River Plant. Annual report for 1978.** Ashley, C.; Zeigler, C.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jan 1981. Contract AC09-76SR00001. 171p. NTIS, PC A08/MF A01. Order Number DE81028471.

The environmental monitoring program at the Savannah River Plant (SRP) provides reliable measurement of radioactive materials released at the source (approximately 40 locations) and present in the environment (approximately 500 locations). In recent years, the environmental monitoring program has been expanded to include measurements of nonradioactive materials released by SRP. A brief discussion of plant releases to the environment and radioactive and nonradioactive materials detected in the environment are presented. The appendices contain data analysis and quality control information, sensitivities of laboratory analyses, tables of environmental sample analyses, and maps of sampling locations.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 29964, 29967

31197 **Air quality and urban waterfront development: a review of government regulations and attitudes.** Ash, T. pp 81-98 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

Air quality is one of the principal constraints to the siting of new facilities on urban waterfronts, especially those with high levels of air pollution even when using advanced abatement technology. Air quality issues in Hudson County illustrate this concern. Afflicted with one of the highest cancer rates in the US, it is part of a region that the US EPA has ranked second in priority nationally for pollution abatement. Certain onshore support facilities for OCS development, such as oil storage, transfer and refining, add a tremendous amount of pollution to the air. Some argue that these facilities should be banned in existing nonattainment areas. (DLS)

31198 **EPA's emission offset policy and energy facility siting.** Merchant, B. pp 99-114 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

Hudson County, New Jersey, with its prime waterfront location, has traditionally been chosen by industry as the site for petrochemical and energy facilities serving New York area, and indeed the whole northeast. In recent years, concern about seriously high concentrations of petrochemical oxidants and other airborne pollutants has caused a backlash among county residents. In coping with the challenge of building new facilities in nonattainment areas, which include most of the country's urban waterfronts, the US EPA has developed an emission offset policy designed to allow sufficient flexibility in implementing the Clean Air Act so as to permit needed growth to occur. Because of the vital importance of this policy to energy facility siting in urban coastal areas, the new emission offset policy is examined. (DLS)

5006 Regulations

REFER ALSO TO CITATION(S) 31197, 31198, 31208

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 31182

5101 Basic Studies

REFER ALSO TO CITATION(S) 31321

31199 **(DOE/EV/00641—45) Mineral cycling in soil and litter arthropod food chains. Progress report, November 1, 1980-October 31, 1981.** Crossley, D.A. Jr. (Georgia Univ., Athens (USA). Dept. of Entomology). 15 Jun 1980. Contract AS09-76EV00641. 33p. NTIS, PC A03/MF A01. Order Number DE81027573.

Progress and current status are reported for research projects concerned with mineral element and nutrient dynamics in soil arthropod food chains. Research is performed within the larger context of terrestrial decomposition, in which soil arthropods may act as regulators of nutrient dynamics during decomposition. Research is measuring rates of nutrient accumulation and excretion by using radioactive tracer analogs of nutrients. This year, emphasis has been placed on field work in which soil arthropod population size and nutrients inputs were varied experimentally. The presence of microarthropods in field microcosms increased the mineralization of N and P in each case, but rates were not correlated with arthropod densities. Experiments recently started are using both arthropod and microfloral inhibitors, in open systems on the forest floor, with the objective of quantifying arthropod enhancement of microbial immobilization of nutrients.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 29887

31200 **(ORNL—5720) Student research activities in the Technology Assessments Section of the Health and Safety Research Division, Summer 1980.** Chester, R.O.; Roberts, D.A. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 113p. NTIS, PC A06/MF A01. Order Number DE81028029.

Reports summarizing activities of students assigned to the Technology Assessments Section of the Health and Safety Research Division for the summer 1980 are presented. Unless indicated otherwise, each report was written by the student whose work is being described. For each student, the student's supervisor, the name of the program under which the student was brought to ORNL, the academic level of the student, and the name of the ORNL project to which the student was assigned are tabulated. The reports are presented in alphabetical order of the students' last names.

31201 **Impacts of permitting delays on investment desirability.** pp 211-231 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

This article examines the effect or delays resulting from the permitting process on the desirability of a proposed refinery investment. To measure the impacts of delays, cost and revenue data were obtained for a refinerery producing 200,000 barrels per day of fuel. Three baseline refinery cases were used. This examination of permitting process impacts as a function of project profitability allows for a more general interpretation of the analysis. (DLS)

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 29888, 30050, 31196, 31250

31202 **(EGG—1183-1791) Aerial radiological survey of the North Anna power station and surrounding area, Mineral, Virginia.** Maguire, T.C.; Steiner, P.A. (EG and G, Inc., Las Vegas, NV (USA). Energy Measurements Group). Jun 1981. Contract AC08-76NV01183. 15p. NTIS, PC A02/MF A01. Order Number DE81028518.

A 1600 km^2 area around the North Anna Power Station near Mineral, Virginia was radiometrically surveyed from an airborne platform during July 1979. No man-made terrestrial gamma-photon emitting radionuclides were detected, although airborne krypton-85 was observed during one survey flight. Aerial count rates from natural emitters were converted to average exposure rates one meter above the ground and presented in the form of an isopleth map. The average levels were between 6 and 10 $\mu R/h$, which included an estimated cosmic ray contribution of 3.7 $\mu R/h$. Exposure rates, measured with a portable ion chamber, and subsequent soil analyses displayed reasonable agreement with the data collected from the aerial platform.

31203 **(IAEA-SM—257/56) On the long-term behavior of ^{129}I in the terrestrial environment.** Kocher, D.C. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 13p. (CONF-810722—7). NTIS, PC A02/MF A01.

From International symposium on migration in the terrestrial environment of long-lived radionuclides from the nuclear fuel cycle; Knoxville, TN, USA (27 Jul 1981).

A linear compartment model of the global iodine cycle has been used to predict the average long-term behavior of ^{129}I in the terrestrial environment following releases, e.g., from nuclear fuel reprocessing and atmospheric weapons testing. The parts of the terrestrial environment considered in this study include the surface soil region, with an assumed depth of 1 m, and shallow and deep subsurface regions of the lithosphere in which ^{129}I is transported via groundwater flow. The mean residence time of ^{129}I in the surface soil region is large considering the corresponding mean residence time for water in the surface soil region of 0.7 y and measured distribution coefficients for iodine in soils. The predicted mean

resident time for ^{129}I in surface soil leads to the conclusion that ingestion of foodstuffs contaminated via root uptake of ^{129}I by plants is the only significant exposure pathway for man for thousands of years following a release to the atmosphere and deposition onto the earth's surface. The predicted mean residence times of ^{129}I in the shallow and deep subsurface compartments of the lithosphere are only about a factor of five greater than the corresponding mean residence times for groundwater in these compartments. This result agrees well with the expectation that ^{129}I transport via groundwater flow is not greatly retarded, and leads to the conclusion that the subsurface lithosphere is not a significant sink for isolating globally circulating ^{129}I from man.

31204 **(PNL—3729) Environmental status of the Hanford Site for CY-1980.** Sula, M.J.; Blumer, P.J.; Dirkes, R.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1981. Contract AC06-76RL01830. 70p. NTIS, PC A04/MF A01. Order Number DE81028358.

Samples of air, surface water, soil, vegetation, and wildlife were collected and external penetrating radiation dose measurements were made in the vicinity of the major operating areas on the Hanford Site. The samples were analyzed for radioactive constituents including tritium, strontium-90, plutonium, and gamma-emitting radionuclides. In addition, site roads, railroad tracks, and burial grounds were surveyed periodically to detect any abnormal levels of radioactivity. Radioactive and nonradioactive waste discharges and environmentally related unusual occurrences reported for the major operating areas were summarized.

31205 **(RHO-CD—782) Surface soil contamination standards.** Boothe, G.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 23 Oct 1979. Contract AC06-77RL01030. 24p. NTIS, PC A02/MF A01. Order Number DE81028398.

The purpose of this document is to define surface soil contamination limits for radioactive materials below which posting, restrictions and environmental controls are not necessary in order to protect personnel and the environment. The standards can also be used to determine if solid waste or other material is contaminated relative to disposal requirements. The derivation of the standards is given.

31206 **Examination of the effect in radiological assessments of high soil-plant concentration ratios for harvested vegetation.** Schwarz, G.; Hoffman, F.O. (Oak Ridge National Lab., TN (USA)). *Health Physics ;* **39**: No. 6, 983-986(Dec 1980).

In this investigation the effect of removal of radioactivity from the root zone of soil by harvesting vegetation exhibiting high soil-to-plant concentration ratios was studied. The importance of harvesting is shown to be a function of the plant-to-soil concentration ratio, the harvested biomass of vegetation, the time-period of accumulation in the soil-root zone and the radiological half-life of the radionuclide.

31207 **Radioisotope detection and dating with accelerators.** Mast, T.S.; Muller, R.A. (Univ. of California, Berkeley). pp 7-32 of Nuclear science applications. Volume 1. Paris, France; Harwood Academic Publishers (1980).

Current research shows the status of the new technique of high energy mass spectrometry. This sensitive method of measuring isotope concentrations has been applied to the detection of rare radioisotopes used for age estimation. A description of the techniques used to select and identify the individual radioisotope atoms in a sample are discussed, and then the status of the radioisotope measurements and their applications are reviewed.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 29964, 29965, 29967, 30875

31208 **(ANL/AA—19) Land use and energy.** Robeck, K.E.; Ballou, S.W.; South, D.W.; Davis, M.J.; Chiu, S.Y.; Baker, J.E.; Dauzvardis, P.A.; Garvey, D.B.; Torpy, M.F. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 177p. NTIS, PC A09/MF A01. Order Number DE81028475.

This report provides estimates of the amount of land required by past and future energy development in the United States and examines major federal legislation that regulates the impact of energy facilities on land use. An example of one land use issue associated with energy development - the potential conflict between surface mining and agriculture - is illustrated by describing the actual and projected changes in land use caused by coal mining in western Indiana. Energy activities addressed in the report include extraction of coal, oil, natural gas, uranium, oil shale, and geothermal steam; uranium processing; preparation of synfuels from coal; oil refineries; fossil-fuel, nuclear, and hydro-electric power plants; biomass energy farms; and disposal of solid wastes generated during combustion of fossil fuels. Approximately 1.1 to 3.3 x 10^6 acres were devoted to these activities in the United States in 1975. As much as 1.8 to 2.0 x 10^6 additional acres could be required by 1990 for new, nonbiomass energy development. The production of grain for fuel ethanol could require an additional 16.9 to 55.7 x 10^6 acres by 1990. Federal laws that directly or indirectly regulate the land-use impacts of energy facilities include the National Environmental Protection Act, Clean Air Act, Federal Water Pollution Control Act, Surface Mining Control and Reclamation Act, and Coastal Zone Management Act. The major provisions of these acts, other relevant federal regulations, and similar state and local regulatons are described in this report. Federal legislation relating to air quality, water quality, and the management of public lands has the greatest potential to influence the location and timing of future energy development in the United States.

31209 **(K-BD—1059-Pt.3) Tornado risk and design windspeeds for the Portsmouth Plant Site.** (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.; Texas Tech Univ., Lubbock (USA). Inst. of Disaster Research). Aug 1975. Contract W-7405-ENG-26. 43p. NTIS, PC A03/MF A01. Order Number DE81028533.

The purpose of this study is to determine the probability of tornadic and straight winds exceeding a threshold value in the geographical region surrounding the Portsmouth, Ohio Plant Site. The probability that winds will exceed a specific value within the lifetime of a structure represents a level of risk that can be associated with design criteria for the structure. The design criteria presented in this study are based on a level of risk represented by a 16% probability that the design windspeed will be exceeded within a 50 year lifetime of the structure. Design criteria associated with other levels of risk can be established from the windspeed probability distribution presented in this report. Probability distributions for windspeeds from tornadoes, extreme winds and a combination of the two are shown. The 16% probability in 50 years is equivalent to a probability of 3.4 x 10^{-3} in one year. A maximum design windspeed of 100 mph is associated with this level of risk. Other parameters associated with this maximum windspeed are determined from tornado vortex mechanics. The extreme wind and tornado parameters are presented. The remainder of the report is devoted to a technical discussion of the development of the windspeed probability distributions. Design criteria for other levels of risk are also presented.

31210 **Refining the waterfront. Alternative energy facility siting policies for urban coastal areas.** Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980). 355p.

Alternative energy facility siting policies for urban coastal areas are discussed with focal points on the older urban coastal areas, alternative patterns of development, economics of energy facility siting, and a look into the future for urban coastal areas. An appendix and bibliography is included in the work. (DLS)

31211 **Coastal zone conflicts and urban opportunities.** Morell,D.; Singer, G. pp 1-15 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

Energy and environmental policies constantly confront conflicting goals in pursuit of an amorphous national interest. Nowhere are these dilemmas more apparent than at the confluence of energy siting, coastal zone management, and urban development. Along the coast rural and urban interests often are in conflict. The research was focused on problems of siting energy facilities on city waterfronts or in alternative locations. The researchers tried to determine mechanisms for finding sites for necessary new energy facilities that are compatible with the conflicting mandates of rural coastline preservation and the changing uses of urban waterfronts. (DLS)

31212 **People and petrochemicals: siting controversies on the urban waterfront.** Singer, G. pp 19-63 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

With nearly every major city in the US located on navigable water and almost half of the US population living within 50 miles of a coast, urban coastal areas play a key role in national affairs. These prime waterfront locations in many cities are ripe for redevelopment. The rural preservationist focus of the federal coastal zone management act of 1972 and many state laws encourage urban siting for those energy and other facilities not wanted in unspoiled areas. Public reactions against waterfront siting are reviewed with emphasis on citizens groups against petrochemical sitings on urban waterfronts. (DLS)

31213 **Urban waterfront: planning perspectives and energy facility siting.** Denitz, P. pp 65-79 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

The emergence of energy self-sufficiency as national policy and major offshore explorations in the Baltimore Canyon, Georges Bank, and other new areas point to the likely need to locate major new onshore support activity. Critical issues of economic social, and aesthetic impact require coastal cities to determine exactly what constitutes the highest and best use of their waterfronts. Broader perspective was gained through an examination of the regional context of waterfront development in Hudson County, New Jersey. Special attention was paid to the attitudes of cities, the county, regional planning agencies, and various advisory boards and activist groups regarding the feasibility and acceptability of creating a regional strategy for waterfront planning. (DLS)

31214 **Case study of a refinery sited in Louisiana.** pp 117-142 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

In April 1974, ECOL, Ltd., was incorporated under the laws of the state of Louisiana to construct and operate a petroleum refinery in the state. The corporation was formed as a result of decision by Ingram Corporation and Northeast Petroleum corporation to undertake a joint project. Within six months, ECOL began construction of the largest refinery ever built in a single phase within the United States. Unlike most US refineries, the ECOL facility was originally designed to produce residual fuel oil rather than gasoline. The market for the fuel oil produced by the ECOL facility was foreseen by the partners as primarily industries and utilities along the East Coast and in the Midwest. From the standpoint of both raw product supply and finished product market, the ECOL principals would have preferred to site their proposed facility on the East Coast, but time was of the essence and anticipated delays in permitting and constructing the facility discouraged ECOL from attemping to site there. ECOL developed a list of 10 basic requirements and then sought sites that met these requirements. While most of these factors involved physical or geographic features, the company was also concerned about local and state economic and political climates.

31215 **Case study of a petrochemical plant sited in Texas.** pp 143-164 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

Corpus Christi Petrochemical Company is representative of the growing trend for oil and chemical companies to diversify into the petrochemical sector. The plant's large size and its dependence on liquid feedstocks also make it illustrative of the future of the petrochemical industry. Like many other petrochemical plants, CCPC has chosen to site near its raw materials and markets. This proximity, the ability to obtain necessary permits, and the generally favorable business climate are probably the major incentives for a petrochemical facility to site in Texas. For CCPC, it is likely that the siting decisions were significanlty affected by the location of the parent companies' facilities. The company's decision to locate near its feedstock source was certainly affected by Champln's knowledge of and strong commitment to the Corpus Christi area. The company appeared to make its siting decision on criteria not unlike those used by an average home buyer. It assessed its particular needs and sought a location where it could obtain land at a reasonable price. the facility required fresh water, power, and accessibility to transportation systems. The company looked for a site on which governmental agencies would allow it to build.

31216 **Energy facility siting on the Gulf Coast: a policy perspective.** pp 165-179 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

It is no longer sufficiient for a company to consider only the economic viability of a potential site. Siting decisions must consider applicable environmental regulations and must take into account local attitudes toward the proposed facility. Texas and Lousiana, the Gulf Coast states producing the greatest amount of raw materials for energy production, were selected for an in-depth exploration of similarities and differences between their siting processes. The factors include state and local approaches to siting, land availabilty, policies of siting, economic impact, and federal intervention. (DLS)

31217 **Alternative energy technologies and the urban coastal zone.** Kirschner, L. pp 259-278 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

Cogeneration, total and integrated energy systems and fuel cell applications may all be quite appropriate for urban siting. Moreover, their implementation could, over time, reduce the number of new power plant sites that would otherwise be needed, in urban areas and elsewhere. Each of these technologies can produce electricity directly; some can also be a source of steam. Each uses fossil fuels efficiently and provides the opportunity for reduced scale. All provide new opportunities for energy conservation. In the case of a facility designed to gasify coal, minemouth sited plants can offer this clean fuel to urban regions striving toward improved air quality.

5106 Regulations

REFER ALSO TO CITATION(S) 31205, 31208

31218 **Economics of permitting: an approach.** pp 183-209 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

Different permit processes and locational scenarios have varying kinds of impacts on the economics of energy facility development. In the northeast US, energy facilities have encountered strong opposition from community organizations and environmental groups. Two issues are of principal importance in this analysis. One is the economic impact of the permitting process on the desirability of an investment in an energy on industrial facility. The other is the possible effects on the location selected for the facility on the permitting process and investment economics. The overall intent is to

determine if the additional costs of innovative siting can be offset by reduced permitting costs. (DLS)

52 ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 31182

5201 Basic Studies

REFER ALSO TO CITATION(S) 31303, 31321

31219 **(LBL—12513) Aspects of feeding in marine zooplankton. Final report.** Shuert, P.G.; Hopkins, T.L. (University of South Florida, St. Petersburg (USA). Dept. of Marine Science). Dec 1980. Contract W-7405-ENG-48. 79p. NTIS, PC A05/MF A01. Order Number DE81028907.

A literature review is presented on feeding in the major types of zooplankton. Considered are the groups commonly taken with plankton nets, the meso- and megaplankton. 286 references. (LEW)

31220 **(ORAU/IEA—81-6(M)) Response of the oceans to increasing atmospheric carbon dioxide.** Baes, C.F. Jr. (Oak Ridge Associated Universities, Inc., TN (USA)). Aug 1981. Contract AC05-76OR00033. 72p. NTIS, PC A04/MF A01. Order Number DE81028178.

The rate at which the oceans take up excess atmospheric carbon dioxide from the burning of fossil fuels is an important factor in determining the rate of increase in the atmospheric concentration of carbon dioxide and the maximum value it will reach. In this review are considered the relevant physical and chemical features of the ocean, the observational evidence of its response to increasing atmospheric carbon dioxide, and the uncertainties involved in modeling this response. The deep oceans are near saturation with calcite (the least soluble form of calcium carbonate). While the pressure dependence of this solubility and ocean circulation tend to produce calcite supersaturation of the upper ocean, these effects cannot account for the far greater supersaturation of the surface waters. This condition is probably maintained by the effects of photosynthesis and the biogenically controlled precipitation of calcium carbonate. After correcting for the expected effects of biological processes on the composition of seawater, several investigators have found evidence that the increasing carbon dioxide content of the atmosphere has already detectably affected the distribution of carbon in the upper ocean. While there are some complications and uncertainties from mixing effects, there seems reason to hope that this signature of excess carbon may soon become a valuable tracer for monitoring ocean response.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 29797, 29798, 29803, 29805, 31036, 31200

31221 **(DOE/EV/70001—59) Composition and manganese association of suspended matter at the head of a southeast Alaskan fjord.** Robb, M.S. (Alaska Univ., Fairbanks (USA). Inst. of Marine Science). May 1981. Contract AT06-76EV70001. 196p. NTIS, PC A09/MF A01. Order Number DE81028320.

Thesis.

Suspended particulate matter (S.P.M.) is a key component in the flux of metals from a riverine source to the sediments and to the deep ocean. Neutron activation analysis of SPM at the head of a southeast Alaskan fjord showed elevated particulate Mn concentrations throughout the water column and low surface and nearbottom concentrations. Detailed investigations of selected particulate samples using scanning electron microscopy and energy dispersive x-ray analysis revealed the presence of Mn in small ($\sim$ 2μm) spherical particles and encrustations. It is postulated that organically stabilized colloidal complexes containing Fe, Mn, P, Al, and Si are periodically flushed from the river and flocculate to produce the observed particles. These particles are quickly diluted by mixing, except during periods when a parcel of water is isolated between the surface circulation and inflow-outflow across the sill: maxima in Mn/Al ratios are observed in these zones. Diagenetic remobilization of Mn from the sediment does occur but is not important when compared to the river input.

31222 **(DOE/EV/70001—60) Transport and reaction of heavy metals in Alaskan fjord estuaries. Annual report, July 1, 1980-May 31, 1981.** Burrell, D.C. (Alaska Univ., Fairbanks (USA). Inst. of Marine Science). May 1981. Contract AT06-76EV0001. 82p. NTIS, PC A05/MF A01. Order Number DE81028319.

The program investigates the potential effects of energy-related chemical pollution in Alaskan fjords. The long-term objective is to understand the chemical, physical, and biological processes responsible for the transport and reaction of heavy metals in these sub-arctic estuaries. The physical circulation and mixing processes, the nature and reactions of terrigenous organics and particulate sediment within the mixing zone, and aspects of the basin sediment oxygen, carbon and nutrient budgets in addition to study of individual metals are investigated. Mainly copper, iron and manganese are being studied since these provide information on physical-chemical processes common to, or greatly affecting, a much wider range of metals. The bulk of the Work completed section of this report refers to Resurrection Bay, a southcentral Alaskan fjord. The Work in progress reported here outlines recent investigations in Boca de Quadra, a southeast Alaskan fjord-estuary. We are here investigating deep and surface water circulation; oxygen, carbon and nutrient budgets; the compositions, reaction and flux of particulate sediment; and organic-heavy metal associations in the freshwater and in the mixing zone.

31223 **Development and application of an in situ x-ray fluorescence spectrometer for underwater sediment analysis.** Wogman, N.A.; Nielson, K.K. (Pacific Northwest Lab., Richland, WA). *Environment International ;* **4**: No. 4, 313-324(1980).

An energy-dispersive x-ray fluorescence spectrometer has been developed that provides in situ analyses for thirty elements in the 5 to 50 ppM range (dry weight) in sediments at water depths to 100 m. The analyzer consists of a radionuclide excitation source. ^{109}Cd, and a solid cryogen-cooled Si(Li) detector with a 0.2-mm beryllium window. The spectrometer has been designed to analyze elements in sediment surfaces as well as a function of sediment depth. The spectrometer has been utilized on a minisubmersible and from a surface vessel. This instrument was applied to several environmental studies. The in situ spectrometer is compared with a laboratory x-ray fluorescence spectrometer.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 30050, 31196, 31224, 31224

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 30216

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 30214, 30215, 30875

31224 **(DOE/EV/00703—3) Mid-Pacific Research Laboratory. Annual report, 1 October 1979-30 September 1980.** Colin, P.L.; Harrison, J.T. III. (Hawaii Univ., Honolulu (USA). Office of Research Administration). Apr 1981. Contract AC08-76EV00703. 38p. NTIS, PC A03/MF A01. Order Number DE81028362.

Progress is reported in the research program which concentrates on sediment bottom communities of the Eniwetak lagoon. Biological and physical-chemical processes of the lagoon floor are relevant to radionuclide mobilization and redistribution. Because of the paucity of general information about the deep lagoon, initial studies were designed to assess benthic community distribution and structure. Two-hundred stations throughout the lagoon are being

surveyed using a camera system designed and built at MPRL. These studies of benthic community distribution are augmented by a concurrent research effort to quantify benthic primary production, community metabolism, and cycling of nutrients between the sediments and the overlying water column. Net daily oxygen and nutrient flow data are tabulated. Facilities are described, community relations are discussed, and a plan for future research is given.

5206 Regulations

REFER ALSO TO CITATION(S) 29806, 31208

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 30673, 30684, 30687

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 30257, 30683, 30684, 30686, 31215, 31217, 31218

31225 **Locational dimensions: the economics of coastal vs. inland and urban vs. rural siting.** pp 233-256 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

The location of a proposed refinery or energy facility can affect the investment decision directly through its impacts on the costs of building or operating the facility. The site can also influence the expected length of he permit process, the probability of successfully receiving all the necessary approvals, or both. To develop an insight into the relationships between facility location, refinery economics, and the permit process several visits were made to oil companies currently undergoing permit review. (DLS)

31226 **Policies for energy facility siting on the urban coast.** Morell, D. pp 285-309 of Refining the waterfront. Alternative energy facility siting policies for urban coastal areas. Morell, D.; Singer, G. (eds.). Cambridge, MA; Oelgeschlager, Gunn & Hain, Publishers, Inc. (1980).

Recommendations for policies which support innovative redevelopment efforts are proposed. The policies include alternate siting strategies for the urban waterfront, urban waterfront revitalization and energy facility siting, economics of energy facility siting, alternate energy technologies and the urban coast, government participation, and federal planning effects. (DLS)

5303 Environmental Impact Statements

REFER ALSO TO CITATION(S) 30334, 30890

55 BIOMEDICAL SCIENCES, BASIC STUDIES

REFER ALSO TO CITATION(S) 31182

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 31219, 31241, 31308

31227 **(LBL—12917) Computerized model to estimate current net migration rates by race, sex, and age.** Schroeder, E.C. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 38p. NTIS, PC A03/MF A01. Order Number DE81028901.

The most recent net migration rates available by race, sex, and age at the county level are the 1960 to 1970 rates as developed by Bowles, Beale, and Lee, (1975). However, the migration patterns in many geographic areas have changed considerably from the 1960's to the 1970's. Using the 1960 to 1970 net migration rates to project into the 1980's can be inappropriate. To obtain better estimates of net migration in the 1970's, a flexible migration submodel was developed based on a methodology described in detail in earlier publications (Pittenger, 1974 and 1978). To estimate the current net migration rates of an area, the character of that area is used. Areas of a similar type, e.g., rural, central city, suburban, etc., usually follow similar migration patterns. A set of about a dozen migration patterns was developed that mimicked most net migration flows. Once a pattern was chosen for a particular area, it was scaled by using total net migration estimates for the area.

31228 **Sensitivity analysis of a mathematical model of phytoplankton growth and nutrient distribution in the Pacific Ocean off the northwestern US coast.** Jamart, B.M.; Winter, D.F.; Banse, K. (Univ. of Washington, Seattle). *Journal of Plankton Research ;* **1**: No. 3, 267-290(1979).

We describe a numerical two-dimensional (time and depth) model of phytoplankton growth and nutrient distribution in the Pacific Ocean off the northwestern US coast. The numerical model consists of coupled integropartial differential equations expressing conservation of chlorophyll a, nitrate, and ammonium. The relevant physical and biological processes are represented by conventional functions and parameters. The system is closed by specification of grazing pressure and light intensity. A long-term simulation over spring and summer months (for convenience, called the standard run) represents well the main features of observed chemical data and biological variables, including the formation and deepening of a subsurface chlorophyll maximum. In this paper, a sensitivity analysis of the system is carried out by comparing the standard run with the results of twenty numerical experiments, in each of which a single function or parameter in the model is modified. The formation of the subsurface chlorophyll maximum is simulated, more or less realistically, in all experiments. Moreover, the results suggest that the chlorophyll distribution adjusts in time and depth so as to optimize the transfer of carbon to secondary producers. The level of the carbon output is determined mainly by the resources available to the primary producers.

5502 Biochemistry

REFER ALSO TO CITATION(S) 31053, 31244, 31248, 31256, 31306, 31310

31229 **Regulation of Cd^{2+}/Zn^{2+}-stimulated metallothionein synthesis during induction, deinduction, and superinduction.** Hildebrand, C.E.; Enger, M.D. *Biochemistry ;* **19**: No. 25, 5850-5857(1980).

Metallothioneins (MTs) are low-molecular-weight, thiol-rich, metal-binding proteins which are synthesized in animal tissues or in cultured cells in response to Cd^{2+} or Zn^{2+} exposure. We have examined regulation of MT synthesis in a Cd^{2}--resistant (Cd/sup r/) Chinese hamster cell which is proficient in induction of MT synthesis following exposure to either Cd^{2+} or Zn^{2+}. The Cd/sup r/ cell MTs are cysteine rich and leucine deficient, bind Zn^{2+} and Cd^{2+} with high affinity, and are synthesized only during exposure of the cells to Cd^{2+} or to excess Zn^{2+}. Induction of MT synthesis is inhibited by 5 μg/mL actinomycin D (AM), indicating that RNA synthesis is required for induction. MT synthesis also is dependent upon the continued exposure to inducing metal since withdrawal of inducer at the time of maximal MT synthesis results in a deinduction of MT synthesis with a half-time of 2 to 3 h. Analyses of induction and deinduction kinetics, together with the results of RNA synthesis inhibitor studies, suggest that indication of MT synthesis is regulated primarily at the level of transcription of thionein mRNA. Finally, the existence of the AM-mediated superinduction of MT synthesis, a phenomenon originally observed in steroid-mediated induction of specific hepatic enzymes, suggests that similar regulatory mechanisms may operate in these quite different inducible systems.

31230 **Separation and measurement of direct and indirect effects of light on stomata.** Sharkey, T.D.; Raschke, K. (Michigan State Univ., East Lansing). Contract EY-76-C-02-1338. *Plant Physiology ;* **68**: No. 1, 33-40(Jul 1981).

Conductance for water vapor, assimilation of CO_2, and intercellular CO_2 concentration of leaves of five species were determined at various irradiances and ambient CO_2 concentrations. Conductance and assimilation were then plotted as functions of irradiance and intercellular CO_2 concentration. On leaves of Xanthium strumarium L., Gossypium hirsutum L., Phaseolus vulgaris L., and Perilla frutescens (L.), Britt., the stomatal response to light was mainly a direct response to light and to a small extent only a response to changes in intercellular CO_2 concentration. This was also true for stomata of Zea mays L., except at irradiances <150 watts per square meter. Stomata responded to light even in leaves whose net exchange of CO_2 was reduced to zero. When leaves were inverted and irradiated on the abaxial surface, conductance decreased in the shaded and increased in the illuminated epidermis, indicating that the photoreceptor pigment(s) involved are located in the epidermis. In leaves of X. strumarium, the direct effect of light on conductance is primarily a response to blue light. Stomatal responses to CO_2 and to light opposed each other. In X. strumarium, stomatal opening in response to light was strongest in CO_2-free air and saturated at lower irradiances than in CO_2-containing air. Conversely, stomatal closure in response to CO_2 was strongest in darkness and it decreased as irradiance increased. In X. strumarium, P. vulgaris, and P. frutescens, an irradiance of 300 watts per square meter was sufficient to eliminate the stomatal response to CO_2 altogether. Application of abscisic acid, or an increase in vapor pressure deficit, or a decrease in leaf temperature reduced the stomatal conductance at light saturation.

31231 Developmental biochemistry of cottonseed embryogenesis and germination. XII. Purification and properties of principal storage proteins. Dure, L. III; Chlan, C. (Univ. of Georgia, Athens). *Plant Physiology ;* **68**: No. 1, 180-186(Jul 1981).

The two principal storage proteins of the cottonseed were purified and partially characterized. They have apparent molecular weights of 52,000 and 48,000 and are both comprised of sets of isoelectric isomers. Both sets have nearly identical solubility properties, ultraviolet absorption spectra, and contain similar proportions of amino acid residues. Furthermore, both sets share antigenic determinants suggesting their origin from a common ancestral gene. However, only the 52,000 set appears to be glycosylated.

31232 Host-pathogen interactions. XVI. Purification and characterization of a β-glucosyl hydrolase/transferase present in the walls of soybean cells. Cline, K.; Albersheim, P. (Univ. of Colorado, Boulder). Contract EY-76-S-02-1426. *Plant Physiology ;* **68**: No. 1, 207-220(Jul 1981).

The fact that fungal glucans will stimulate soybeans to accumulate phytoalexins prompted an investigation of soybean cell β-1,3-glucanases and β-glucosidases, as well as the ability of these enzymes to hydrolyze the fungal glucans. Several β-1,3-glucanases and β-glucosidases can be solubilized from the walls of suspension-cultured soybean cells. An enzyme, which has been termed β-glucosylase I, is the dominant β-1,3-glucanase in the cell wall extracts. β-Glucosylase I was purified 71-fold, with 39% recovery, from the mixture of cell wall enzymes. β-Glucosylase I yields a single band on isoelectric focusing gels (pH 8.9). However, the purified β-glucosylase I yields a darkly-staining protein band at an apparent molecular weight of 69,000 and several lightly-staining protein bands in sodium dodecyl sulfate polyacrylamide gels. Additional purification procedures fail to remove these lightly-staining protein bands. β-Glucosylase I possesses β-glucanase activity. The enzyme hydrolyzes polysaccharide substrates in an exo manner. β-Glucosylase I will also hydrolyze a variety of low molecular weight β-glucosides including various β-linked diglucosides. Thus, β-glucosylase I also posseses β-glucosidase activity. Several lines of evidence are presented that the β-glucanase and the β-glucosidase activities exhibited by purified β-glucosylase I preparations are catalyzed by the same enzyme. The ability of β-glucosylase I to catalyze glucosyl transfer indicates that β-glucosylase I is biochemically more similar to previously studied β-glucosidases than to β-glucanases. This conclusion is supported by the observation that β-glucosylase I is strongly inhibited by 1,5-D-gluconolactone, an inhibitor of β-glucosidases but not of β-glucanases.

31233 Host-pathogen interactions. XVII. Hydrolysis of biologically active fungal glucans by enzymes isolated from soybean cells. Cline, K.; Albersheim, P. (Univ. of Colorado, Boulder). Contract EY-76-S-02-1246. *Plant Physiology ;* **68**: No. 1, 221-228(Jul 1981).

The ability of β-glucosylase I, a soybean cell wall β-glucosyl hydrolase, to degrade elicitors of phytoalexin accumulation was studied. Extensive β-glucosylase I treatment of the glucan elicitor isolated from the mycelial walls of Phytophthora megasperma var. sojae results in hydrolysis of 77% of the glucosidic bonds of the elicitor and destruction of 94% of its activity. Soybean cell walls contain some additional factor, probably one or more additional enzymes, which can assist β-glucosylase I in hydrolyzing the glucan elicitor. In a single treatment, the mixture of cell wall enzymes hydrolyzed 91% of the glucosidic bonds and destroyed 85% of the activity of the elicitor. The enzymes from soybean cell walls will also hydrolyze elicitor-active oligoglucosides prepared from the mycelial walls of Phytophthora megasperma var. sojae. The active oligoglucosides are more susceptible than the glucan elicitor to hydrolysis by these enzymes. The mixture of cell wall enzymes or β-glucosylase I, by itself, hydrolyzes more than 96% of the glucosidic bonds and destroys more than 99% of the activity of the oligoglucoside elicitor. Two possible advantages for the existence of these enzymes in the walls of soybean cells are discussed.

31234 Phosphorylation of heavy sacroplasmic reticulum vesicles: identification and characterization of three phosphorylated proteins. Campbell, K.P.; Shamoo, A.E. (Univ. of Rochester, NY). *Journal of Membrane Biology ;* **56**: 241-248(1980).

Heavy sacroplasmic reticulum vesicles derived from the terminal cisternae of the sacroplasmic reticulum have been shown to contain endogenous protein kinase activity and associated substrate proteins. Phosphorylation of these proteins of 64,000 daltons (E1), 42,000 daltons (E2), and 20,000 daltons (E3) was observed in the presence of 1 mM EGTA. Phosphorylation of these proteins was cAMP-independent, hydroxylamine-resistant, and was seen without the addition of protein kinase. The presence of high calcium (5 mM) during electrophoresis caused calsequestrin to run at a lower molecular weight (~ 56,000 instead of 64,000 daltons), and correspondingly the phosphoprotein E1 ran at a lower molecular weight. Finally, calsequestrin purified by a double gel electrophoresis method has been shown to be phosphorylated.

31235 Detection of atypical bile acids in disease states and their identification by gas chromatography-mass spectrometry-computer techniques. Szczepanik-Van Leeuwen, P.A.; Stellaard, F. *Falk Symposium ;* **26**: 287-298(1978).

In conclusion, we believe that atypical bile acids can be readily identified with great sensitivity by GC/CI mass spectrometry. We also believe that such bile acid analysis may prove useful to the study and diagnosis of liver disease. Present data suggest that the identification of atypical bile acids in biological samples may enable differentiation between different types of intrahepatic cholestasis. Such analyses may prove useful to distinguish specific diseases - such as Byler's disease (and Byler-like cholestasis) from other types of cholestasis, and may distinguish diseases involving mitochondrial defects. Finally, the presence of atypical bile acids may indicate, by the particular compounds formed, where and what kind of damage occurs in a disease, and may ultimately establish whether these atypical bile acids are a cause or effect of the liver damage.

5503 Cytology

REFER ALSO TO CITATION(S) 31308

31236 (DOE/ER/73019—58) Studies on the control of cell-wall extension. Three year progress report, September 1, 1978-June 30, 1981. Cleland, R.E. (Washington Univ., Seattle (USA). Dept. of Botany). 30 Jun 1981. Contract AT06-76ER73019. 31p. NTIS, PC A03/MF A01. Order Number DE81027942.

Various parameters of plant cell growth are being assessed under conditions where growth is being enhanced or inhibited, in

order to explain at the cellular level how growth is controlled. (ACR)

31237 **(DOE/EV/02814—3) Molecular basis of the mutagenic and lethal effects of ultraviolet irradiation.** (Johns Hopkins Univ., Baltimore, MD (USA). School of Hygiene and Public Health). 1981. Contract AS02-76EV02814. 9p. NTIS, PC A02/MF A01. Order Number DE81028535.

In the last few years it has become increasingly apparent that the enzymatic reactions leading to the incision of ultraviolet (UV) irradiated DNA are more complicated than the original single step model suggested. There may be at least two mechanisms to account for the multigenic control of this rate-limiting process. This mechanism is examined directly in mammalian cells by genetic complementation and immunological analysis of repair deficient human cell lines derived from patients with the repair deficiency xeroderma pigmentosum (XP).

31238 **X-ray and neutron scattering density profiles of the intact human red blood cell membrane.** McCaughan, L.; Krimm, S. (Univ. of Michigan, Ann Arbor). *Science ;* **207**: No. 4438, 1481-1483(28 Mar 1980).

Hemoglobin-free human red blood cell membranes have been prepared with glutaraldehyde to maintain an intact structure on partial dehydration. Treatment of resealed ghosts with poly(L-lysine) produced an essentially constant structural unit and permitted correlation of electron microscopy results with x-ray and neutron diffraction profiles. These profiles provide detailed information, for the intact membrane, on the location and relative distribution of lipids and proteins.

31239 **Use of fluorescence correlation spectroscopy to probe chromatin in the cell nucleus.** Sorscher, S.M.; Bartholomew, J.C.; Klein, M.P. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Biochimica et Biophysica Acta ;* **610**: 28-46(1980).

All systems in thermodynamic equilibrium are subject to spontaneous fluctuations from equilibrium. For very small systems, the fluctuations can be made apparent, and can be used to study the behavior of the system without introducing any external perturbations. The mean squared amplitude of these fluctuations contains information about the absolute size of the system. The characteristic time of the fluctuation autocorrelation function contains kinetic information. In the experiments reported here, these concepts are applied to the binding equilibrium between ethidium bromide and DNA, a system where the fluorescence properties of the dye greatly enhance the effect of spontaneous fluctuations in the binding equilibrium. Preliminary experiments employ well-characterized DNA preparations, including calf thymus DNA, SV40 DNA, and calf thymus nucleohistone particles. Additional measurements are described which have been made in small regions of individual nuclei, isolated from green monkey kidney cells, observing as few as 5000 dye molecules. The data indicate that the strength of dye binding increases in nuclei isolated from cells which have been stimulated to enter the cell growth cycle. The viscosity of nuclear material is inferred to be between one and two orders of magnitude greater than that of water, and it decreases as the cells leave the resting state and enter the cell growth cycle. Washing the nuclei also lowers the viscosity. These experiments demonstrate that fluorescence correlation spectroscopy can provide information at the subnuclear level that is otherwise available.

5504 Genetics

REFER ALSO TO CITATION(S) 31231

31240 **(DOE/EV/04182—T1) Differential gene expression in Neurospora crassa cell types: heterogeneity and amplification of rRNA genes. Progress report, July 1980-June 30, 1981.** Dutta, S.K. (Howard Univ., Washington, DC (USA)). 1981. Contract AS05-76EV04182. 18p. NTIS, PC A02/MF A01. Order Number DE81026730.

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The significant results obtained during 1980-1981 year of the current research program are as follows: I. Studies on heterogeneity of multiple copies of rDNAs from N. crassa cell types are being continued, such as: (1) Autoradiographs of Southern transfers of $EcoR_1$ restricted fragments of nuclear DNA from conidia, germinated conidia (sprouts) and mycelia of N. crassa were compared after hybridization with ^{32}P-rDNA probe. The nuclear DNA of two hours sprout and of 16 hours mycelia gave similar hybridization patterns with $EcoR_1$ digest, but no such hybridization pattern was evident in conidial DNA digest; (2) Procedure for concentration of rDNAs from Neurospora species and cell types was standardized; restriction analysis of purified rDNAs is being done; (3) 35S total rDNA clone, 17S rDNA clone and 26S rDNA subclone are being used to see gross differences in the precursor rRNAs of different cell types; (4) Comparison of DNA:DNA homologies of rRNA genes with different Neurospora species. II. Post-mitochondrial DNAs of N. crassa are found to be rDNA-like and were further characterized by electron microscopic studies and are found to be approximately twice the size of SV-40 DNAs. These N. crassa post-mitochondrial DNAs hybridized with ^{32}P-labeled N. crassa nuclear DNAs. III. Previous studies on differential RNase sensitive DNA polymerase activity in N. Crassa cell types and on evolution of sexual morphogenesis in the genus Neurospora are completed and published. RNase sensitive DNA polymerase activity is found to be in the post-mitochondrial fraction. Heterothallism in the genus Neurospora is evolved from homothallism.

31241 **Sampling strategies for the analysis of quantitative traits.** Moll, P.P.; Sing, C.F. (Univ. of Michigan Medical School, Ann Arbor). pp 307-342 of Genetic analysis of common diseases: applications to predictive factors in coronary disease. New York, NY; Alan R. Liss, Inc. (1979).

A population consists of a distribution of genetic and environmental relationships among individuals which cannot be represented by any one fixed design. It seems reasonable to hypothesize that sampling these relationships according to some mixed sampling scheme will give us more realistic estimates of the influences of those genetic and environmental factors which determine the distribution of the trait among and within families in a population. Consequently, it follows that we must also evaluate the statistical properties of estimates from samples composed of different combinations of sampling units. Once we have chosen the competing hypotheses to test, such information about sampling designs can be used to select the units or combination of units which will give us the most powerful tests. In a similiar vein, the effects of different pedigree configurations on the outcome of linkage analysis have been investigated. Regardless of the sample unit chosen, the ascertainment procedures used to obtain the data present another dimension of sampling which has only recently been considered. The additional problem presented by genetic heterogeneity has received even less attention. From this review it is apparent that more effort must be directed toward research studies to understand how well the various available design options will contribute to the success of future studies to understand quantitative variation in human populations.

31242 **(UCD—34P200X2) Genetic structure of natural populations. Progress report.** Ayala, F.J. (California Univ., Davis (USA). Dept. of Genetics). 20 Aug 1975. Contract AT03-76EV70200. 14p. NTIS, PC A02/MF A01. Order Number DE81025728.

Research progress during fiscal year 1974-1975 is reported. Projects include the study of genetic load in natural populations of Drosophila melanogaster; protein polymorphisms and natural selection; genetic variation at the molecular level; enzyme activity and gene regulation; and genetic polymorphism and environmental stability. (ACR)

31243 **Mating signals control expression of mutations resulting from insertion of a transposable repetitive element adjacent to diverse yeast genes.** Errede, B. (Univ. of Rochester, NY); Cardillo, T.S.; Sherman, F.; Dubois, E.; Deschamps, J.; Wiame, J.M. *Cell ;* **25**: 427-436(Nov 1980).

ROAM mutations cause overproduction in S. cerevisiae. Overproduction of ROAM mutant gene products is less in MATa/MATα diploid strains which cannot conjugate than in haploid strains which can. Overproduction occurs in diploid strains capable of mating whether or not they are capable of sporulating. Overproduction decreases when haploid ROAM mutants also contain the

ste7 mutation which prevents conjugation; other ste mutations do not affect the expression of ROAM mutations. Cloning of the ROAM mutant gene CYC7-H2 shows that a 5.5 kb sequence homologous to a transposable and reiterated Ty1 element is inserted in the 5' noncoding region of the CYC7 structural locus. The similar genetic properties of other ROAM mutations suggest that they each contain an inserted Ty element. These results also suggest that ROAM mutations respond to signals normally directed toward genes controlling conjugation functions, and that sequences present in Ty elements may be adjacent to structural loci and are the normal receptors for these signals.

31244 **Hepatitis-Bs antigen in an isolated Indian population of southern Venezuela: a family study.** Soyano, A.; Layrisse, Z.; Layrisse, M.; Neel, J.V. (Instituto Venezolano de Investigaciones Cientificas, Caracas). *Journal of Medical Genetics ;* **16**: 201-205(1979).

A genetic analysis of the presence of HBsAg in a population of which 7.2% of the members were positive is presented. Though the ratios of carriers:non-carriers were generally in good agreement with expectation if the carrier state were determined by homozygosity for a single recessive gene, the two examples of mating most critical to a test of the hypothesis, carrier x carrier, yielded 2 normal children among 4 in one family, and one normal child, the only offspring, in the second family. Other investigators have reported similar findings. We conclude that the hypothesis of simple recessive inheritance cannot be sustained.

5505 Metabolism

REFER ALSO TO CITATION(S) 31235, 31257

5506 Medicine

REFER ALSO TO CITATION(S) 31265, 31268, 31269, 31278, 31287, 31288, 31298, 31299, 31300, 31304

31245 **(CONF-810606—85) Impact of risk considerations on dosimetry of radiopharmaceuticals.** Eckerman, K.F. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE81028610.

From American Nuclear Society's annual meeting; Miami Beach, FL, USA (7 Jun 1981).

Estimates of the absorbed dose from clinical procedures involving the administration of radiopharmaceuticals are used primarily to determine the presumed risk of various procedures so that, inso-far as possible, the selection of a given procedure can be based on a comparison of risk. Although this has been the basic objective, risk evaluation has generally been separated from the dosimetry considerations. In the recent revision of its radiation protection guidance, the International Commission on Radiological Protection (ICRP) has embodied risk considerations in its recommendations and risk concepts have become an integral part of the dosimetric framework. The impact of these considerations on the dosimetric assessments of radiopharmaceuticals and the resulting need for additional information is discussed.

31246 **Radioiodinated fatty acids for myocardial imaging: effects of chain length.** Otto, C.A.; Brown, L.E.; Wieland, D.M.; Beierwaltes, W.H. (Univ. of Michigan, Ann Arbor). Contract EY-76-5-02-2031. *Journal of Nuclear Medicine ;* **22**: No. 7, 613-618(Jul 1981).

Terminally iodinated long-chain fatty acids have been used experimentally and clinically as myocardial imaging agents. Six ω-iodo fatty acids ($I(CH_3)$/sub n/CO_2H, where n = 10, 12, 15, 18, 21, 26) have been synthesized and tested in rats. Myocardial extraction values and heart-to-blood ratios are affected by chain length. Extraction is shown to be highest for n = 18 and 21, as are heart-to-blood ratios at 5 min. The cellular fate of the fatty acid changes from that of β-oxidation for $n \leqq 15$ to predominantly triglyceride storage for n = 18 and 21, as shown by analysis of rat heart homogenates by thin layer chromatography at two time intervals.

31247 **(DOE/EV/04318—4) Preparation of gallium-68 radiopharmaceuticals for positron tomography. Progress report, November 1, 1980-December 31, 1981.** Welch, M.J. (Washington Univ., St. Louis, MO (USA). Edward Mallinckrodt Inst. of Radiology). Jun 1981. Contract AS02-77EV04318. 94p. NTIS, PC A05/MF A01. Order Number DE81029092.

Although the germanium-68 → gallium-68 generator is probably the only source of positron-emitting radionuclides that could enable the widespread application of positron tomography, the commercially available $^{68}Ga/^{68}Ge$ generator system suffers from several major disadvantages. The most important of these is that the generator is eluted with EDTA, which forms a very strong chelate with gallium. In order to produce radiopharmaceuticals other than ^{68}Ga-EDTA, it is first necessary to break the stable EDTA complex and remove all traces of EDTA. This procedure adds several steps and a significant amount of time to procedures for preparing ^{67}Ga-radiopharmaceuticals. Several years ago, we developed a new generator using a solvent extraction system which produces ^{68}Ga-oxine (8-hydroxyquinoline), a weak chelate. We have also carried out studies to compare generator systems which produce ^{68}Ga in an ionic form. Using the gallium-68 eluted from these various generator systems, several ^{68}Ga-labeled radiopharmaceuticals have been synthesized and tested in vitro and in vivo. In addition, attempts have been made to design and synthesize a lipophilic ligand for gallium-68. The stability of radiogallium complexed with a series of potentially lipophilic complexing agents has been studied using chromatographic techniques and in vivo distribution data. The potential of these complexing agents for altering the biodistribution of gallium radiopharmaceuticals has also been investigated.

31248 **(DOE/SF/00012—T13) Research and development program, fiscal year 1964.** (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 25 Apr 1962. Contract AC03-76SF00012. 101p. NTIS, PC A06/MF A01. Order Number DE81026135.

Progress for fiscal year 1962 is reported in the following areas of research: somatic effects of radiation; combating detrimental effects of radiation; molecular and cellular level studies; environmental radiation studies; radiological and health physics and instrumentation; chemical toxicity; cancer research; and selected beneficial applications. Overall objections, as well as plans for fiscal years 1963 and 1964, are discussed. (JGB)

31249 (LBL—11700, pp 7) **Data acquisition, reconstruction, and display.** Huesman, R.H. Mar 1981. NTIS, PC A08/MF A01.

In Biology and medicine division annual report, 1979-1980.

A special emphasis of the Research Medicine program is the development of methods for acquiring and manipulating data from the Donner 280-crystal positron emission tomograph. This past year, development of a system capable of taking 1 million events per second while simultaneously correcting for unwanted accidental coincidence events was completed. The system permits the simultaneous acquisition of data for eight different time-slices of the cardiac cycle. A microprocessor responds to the patient's electrocardiogram (EKG) signal, routing data to the histogram memory corresponding to the phase of the cardiac cycle indicated by the signal. Additional work completed this year includes quantitation of the signal-to-noise ratio to be expected when imaging the human head. Effort is continuing on the more complicated problem of noise propagation in reconstructions of the human thorax.

31250 **(ORNL—5750) Health and Safety Research Division. Progress report, October 1, 1979-March 31, 1981.** (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 109p. NTIS, PC A06/MF A01. Order Number DE81026088.

Research progress for the period October 1, 1979 through March 31, 1981 is reported. Research conducted by the Office of Integrated Assessments and Policy Analysis, Health Studies Section, Technology Assessments Section, Biological and Radiation Physics Section, and Chemical Physics Section is summarized. (ACR)

31251 (JPRS—78499) USSR report: space biology and aerospace medicine. Translation of *Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina ;* **15**: No. 3, 4-96(May 1981). 159p. NTIS. Order Number DE81903568.

The report contains translations of articles dealing with the physiology and psychology of humans during space flight; recycling of water and organic acids in closed systems; and the biological effects of space flight on experimental animals. Items within the scope of EDB are entered individually. (ACR)

31252 Radionuclide scans not indicated for clinical Stage I melanoma. Evans, R.A.; Bland, K.I.; McMurtrey, M.J.; Ballantyne, A.J. *Surgery, Gynecology and Obstetrics ;* **150**: No. 4, 532-534(Apr 1980).

One hundred and sixty-two scans of the liver and 160 scans of the brain were performed upon 230 patients with clinical Stage I melanoma. No patient was found to have a true-positive scan. However, there were two false-positive scans of the liver and two false-positive scans of the brain. One craniotomy, two arteriograms, and numerous follow-up scans were done to confirm that these scans were false-positive. The cost of the 322 screening scans was $23,964, and the expense of follow-up evaluation was considerably greater. The authors have discontinued the use of scans of the liver and brain in the evaluation of asymptomatic patients with Stage I melanoma.

31253 Biomedical applications of pion-producing accelerators. Rosen, L. (Los Alamos Scientific Lab., NM (USA)). *Proceedings of the Japan Conference on Radioisotopes ;* No. 14, 256-278(1980).

From 14. Japan Conference on radioisotopes; Tokyo, Japan (20 - 21 Nov 1979).

It was proved by the Los Alamos Scientific Laboratory of the U. S. that applications of pi-mesons in the treatment of cancer could eliminate the problem of dose localization attendant upon conventional radiation therapy. A negative pi-meson, once it is produced from energy, behaves quantum mechanically like an electron and executes orbits around a nucleus. Because its mass is 300 times that of an electron, the orbits are smaller in that ratio. Hence, on achieving the innermost orbit, the pi-meson is captured by the nucleus and causes it to explode. The resultant nuclear shrapnel travel very short distances, about 1 mm on the average, and are very effective in rendering afflicted cells non-productive without causing any damages to healthy cells in the vicinity of the tumor. Given pion therapy, over 100 patients showed encouraging results. The laboratory, sponsored by the National Cancer Institute, is now developing a small facility for pion therapy. Tests on the critical components of the pion generator are expected to be conducted within the next 12 - 16 months.

5507 Microbiology

REFER ALSO TO CITATION(S) 29939, 31228, 31243

31254 (DOE/EV/03941—57) Pathway of plasmid transformation in pneumococcus. Guild, W.R.; Saunders, C.W. (Duke Univ., Durham, NC (USA). Dept. of Biochemistry). 1981. Contract AS05-76EV03941. 9p. (CONF-810150—1). NTIS, PC A02/MF A01. Order Number DE81025931.

From International plasmid conference; Santo Domingo, Dominican Republic (5 Jan 1981).

Plasmids transform Streptococcus pneumoniae by a process involving low efficiency assembly of replicons from fragments of single strands that have entered the cell separately. Transformation of preexisting replicons is much more efficient. We have cloned the erm gene of pIP501 into pMV158, which so far as we know is the first example of cloning in a pneumococcus host-vector system.

5509 Pathology

REFER ALSO TO CITATION(S) 31232, 31233

31255 (DOE/EV/03264—20) Inborn anemias in mice. Bernstein, S.E.; Barker, J.E.; Russell, E.S. (Jackson Lab., Bar Harbor, ME (USA)). Jun 1981. Contract AS02-76EV03264. 36p. NTIS, PC A03/MF A01. Order Number DE81029128.

hereditary anemias of mice have been the chief objects of investigation. At present under study are four macrocytic anemias, five hemolytic anemias, nonhemolytic microcytic anemia, transitory siderocytic anemia, sex-linked iron-transport anemia, an α-thalassemia, and a new target-cell anemia. Each of these blood dyscrasias is caused by the action of a unique mutant gene, which determines the structure of different intracellular molecules, and thus controls a different metabolic process. Thus our wide range of different hereditary anemias has considerable potential for uncovering many different aspects of hemopoietic homeostatic mechanisms in the mouse. Each anemia is studied through: (a) characterization of peripheral blood values, (b) determinations of radiosensitivity under a variety of conditions, (c) measurements of iron metabolism and heme synthesis, (d) histological and biochemical study of blood-forming tissue, (e) functional tests of the stem cell component, (f) examination of responses to erythroid stimuli, and (g) transplantation of tissue between individuals of differently affected genotypes.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 31230, 31231, 31235, 31308

31256 Developmental biochemistry of cottonseed embryogenesis and germination. XIII. Regulation of biosynthesis of principal storage proteins. Dure, L. III; Galau, G.A. (Univ. of Georgia, Athens). *Plant Physiology ;* **68**: No. 1, 187-194(Jul 1981).

The synthesis of the principal cottonseed storage proteins during embryogenesis was followed by analyses of protein synthesized in vivo and from purified RNA in vitro in the wheat germ system. The kinetics of in vivo labeling as well as immunochemical cross-reactivity indicate that the 52- and 48-kilodalton mature storage protein sets are derived from 70- and 67-kilodalton precursor protein sets that are abundant proteins in embryonic cotyledons and disappear in late embryogenesis. Identification of the initial translation products of the storage protein mRNA has not been clearly established although products of apparent molecular weights of 69,000 and 60,000 are the likely storage protein precursors. Storage protein synthesis falls off markedly in late embryogenesis simultaneously with the loss of a superabundant class of mRNAs that are presumed to be those for the storage proteins. The synthesis of these proteins ceases abruptly when immature embryos are removed from the boll and allowed to germinate precociously or when this precocious germination is prevented by incubation in abscisic acid. Thus, abscisic acid is not implicated in the expression of the storage protein genes. A scheme involving co-translational processing into vesicles, glycosylation, and slow in situ cleavage to produce the mature storage proteins is proposed.

5520 Public Health

REFER ALSO TO CITATION(S) 31188, 31305

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 31230, 31231, 31232, 31233, 31256

31257 Seasonal changes in energy allocation by white oak (Quercus alba). McLaughlin, S.B. (Oak Ridge National Lab., TN); McConathy, R.K.; Barnes, R.L.; Edwards, N.T. *Canadian Journal of Forest Research ;* **10**: No. 3, 379-388(1980).

Seasonal patterns of change in lipids, sugars, starch, labile constituents, holocellulose, and lignin were studied in six forest-grown wite oak trees. Contents of metabolically active constituents in leaves, twigs, branches, boles and roots were used to construct whole-tree budgets of energy allocation. [^{14}C]Sucrose was also

concurrently supplied to the study trees to follow the fate and efficiency of utilization of food reserves. Results showed that white oak rapidly mobilized and replaced food reserves during the critical period of canopy generation in the spring. Starch was more important as a reserve food than lipids or sugar. Large fluctuations in starch in roots in spring and fall suggested a bimodal belowground growth pattern. Labile constituents showed the most pronounced seasonal changes and dominated the calculated whole-tree energy flux patterns. Rapid decline in labile compounds in early spring and a parallel increase in holocellulose suggested a possible pattern of mobilization and resupply of stored reserves associated with in cell wells. This possibility was supported by a concurrent shift of labile ^{14}C to nonlabile ^{14}C in tissues. Canopy generation was calculated to have cost $\leqq$ 17.7 kg of glucose of which 13 kg appeared to have come from within the canopy.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

REFER ALSO TO CITATION(S) 31182

5601 Radiation Effects

REFER ALSO TO CITATION(S) 31059, 31138, 31246, 31248, 31248, 31250, 31255, 31300, 31420

31258 (DOE/EV/04322—T1) **Annual progress report.** Little, J.B. (Harvard Univ., Boston, MA (USA). School of Public Health). 1 Jun 1981. Contract AS02-77EV04322. 13p. NTIS, PC A02/MF A01. Order Number DE81027899.

Emphasis during the past year has been on studies of the effects of potential promoting agents on radiation transformation, and of transformation by internal radionuclides emitting high LET radiation. We have also carried out a detailed investigation of the dosimetry of our alpha radiation source. Preliminary studies on the mechanisms of radiation transformation have been initiated as described in the previous proposal. Studies on promotion have focused on the effects of: (1) the endogenous steroid hormone 17-β-estradiol; (2) the non-steroidal anti-inflammatory agent indomethacin; (3) the endogenous growth factor called Epidermal Growth Factor (EGF); and (4) Melittin, a stimulator of prostaglandins synthesis.

31259 (DOE/EV/04733—T1) **Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.** (Columbia Univ., New York (USA). Radiological Research Lab.). Jul 1981. Contract AS02-78EV04733. 302p. (COO—4733-4). NTIS, PC A14/MF A01. Order Number DE81025259.

Separate abstracts were prepared for the 29 papers in this progress report which deal with radiobiological physics, the biological effects of ionizing radiations, and the modification of these effects by chemical and pharmacological agents. (KRM)

31260 (DOE/EV/04733—T1, pp 103-108) **Collaborative studies at RERF.** Kellerer, A.M.; Rossi, H.H. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

Because of strong interest in radiation epidemiology and especially because of its impact on the theoretical and experimental research program of this Laboratory we considered it most desirable to establish direct contact with the Radiation Effects Research Foundation (RERF). On the basis of previous considerations and following discussions with several investigators at RERF we formulated two research proposals. One of these is designed to produce a general overview of some of the vast amount of data gathered at RERF. The aim of the other project is to avoid two limitations of the conventional epidemiological analysis of radiation carcinogenesis. Our proposed methods do not require assignment of individuals into relatively coarse intervals of kerma and the analysis is non-parametric (i.e., it does not assume linear, quadratic, etc. dose-effect relations).

31261 (DOE/EV/04733—T1, pp 109-117) **Analysis of the cataractogenic potential of fast argon ions.** Zaider, M.; Rossi, H.H. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

A series of experiments have been conducted by a group of the Ocular Radiation Research Laboratory of the Department of Ophthalmology (GRM and BVW) in order to investigate the cataractogenic potential of various doses of accelerated argon (^{40}A) ions. A second objective of this study was to assess the RBE of heavy ions compared with low-LET radiation, for which extensive results have been previously obtained. The experiments were performed on four-week old Columbia-Sherman rats exposed to doses of 0.01, 0.07, 0.5, and 3.5 Gy of ^{40}A particles (E = 540 MeV/amu). The irradiations were carried out at the Bevalac Facility of the Lawrence Berkeley Laboratory. Two additional groups of animals have been observed: a control group (0 dose) and a group exposed to 3.5 Gy of 185 kVp x-rays. Cataracts were scored as a function of time after irradiation using an arbitrary scale (0 to 4) developed by Merriam and Focht. At the present time two procedures have been selected such that the effects of the arbitrary scoring system are avoided. The first method is based on the observation that the cumulative distribution of animals corresponding to a given stage, or beyond, can be conveniently approximated with a log-normal distribution. The second method, based on the Mann-Whitney rank-order test is used to compare groups of irradiated and unirradiated animals as a function of time after exposure.

31262 (DOE/EV/04733—T1, pp 118-127) **Tests of normality for the number of survivors and related quantities.** Zaider, M.; Kellerer, A.M. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

The purpose of this report is to examine one of the most common assumptions made in the statistical analysis of survival data, namely that for a given dose, the distribution in the number of surviving cells is approximately normal. A similar assumption is examined for the distribution of ln (survivors) since this is the quantity most frequently used in least squares-based analyses. Two tests have been chosen: a test for asymmetry using the sample skewness and a direct test for normality using the Kolmogorov-Smirnov distributions. These two procedures are described in the next two sections. The last section describes the results of applying the tests to a rather large volume of survival data.

31263 (DOE/EV/04733—T1, pp 130-138) **Interaction of x-rays and food pyrolysis products in producing oncogenic transformation in vitro.** Borek, C.; Ong, A. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

In recent years it has become evident from epidemiological and experimental data that a large number of environmental factors, including diet, play a role in modifying the incidence of cancer. Cell culture systems in which oncogenic transformation serves as an end point are powerful tools for evaluating these questions. Using such systems it has been shown recently that pyrolysis products from charred surfaces of broiled meat and fish can transform hamster embryo cells in vitro as well as produce tumors in the animal. Our studies in vitro have demonstrated the oncogenic potential of ionizing radiation in both hamster and human cells and have established in hamster cells the dose response relationship at doses ranging from 1 to 600 rad for x-rays and 0.1 to 150 rad for neutrons. The present work was aimed at evaluating whether there exists a cocarcinogenic interaction between a pyrolysis product and x-rays in their ability to transform hamster embryo cells in vitro. We have found that when cells are exposed to x-rays prior to treatment with the pyrolysis product there appears to be a synergistic interaction between the two agents in their ability to transform the cells.

31264 (DOE/EV/04733—T1, pp 139-143) **Modulation of x-ray induced oncogenic transformation by thyroid hormone.** Ong, A.; Borek, C. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

We describe experiments which show that the presence of thyroid hormone is necessary for in vitro neoplastic transformation by x rays in cells of an established mouse fibroblast culture (C3H/10T 1/2) and in early-passage diploid hamster embryo cells. In vitro transformation x rays has been especially well investigated in early-passage primary hamster embryo cells in culture and C3H/10T 1/2 mouse embryo fibroblasts, and qualitatively demonstrated in human diploid cells. Accordingly we have used in this study (1) short-term cultures of diploid hamster embryo cells (HE) obtained as previously described, and (2) the C3H/10T 1/2 clone 8 mouse embryo heterodiploid cell line. We have measured the efficacy of x rays in inducing neoplastic transformations in cell cultures of both types when thyroid hormone has been removed from the culture medium and find that transformation is inhibited. We have also shown that the efficacy of x rays in causing neoplastic transformation is restored when thyroid hormone (triiodothyronine, T_3) is added to the hormone-depleted medium.

31265 (DOE/EV/04733—T1, pp 149-154) **Oncogenic transformation in vitro; the interaction of x-rays with hyperthermia.** Miller, R.C.; Harisiadis, L.; Hall, E.J.; Napholz, A. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

The current interest in the use of hyperthermia for the treatment of cancer, either alone or in combination with x-rays, prompted the present investigation of the oncogenic potential of hyperthermia, using an established in vitro transformation assay system, C3H/10T 1/2 cells.

31266 (DOE/EV/04733—T1, pp 155-167) **Effect of cell density on the in vitro transformation of C3H-10T 1/2 mouse embryo fibroblast cells by x rays.** Furcinitti, P.S. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

The mouse embryo fibroblast derived C3H-10T 1/2 cell line has been used widely as an in vitro model for studying carcinogenesis. This cell line shows postconfluent contact inhibition of growth except when treated with chemical or physical carcinogens in which case a dose dependent incidence of transformed foci (Types II and III) is observed. This investigation was undertaken in order to better characterize the phenomenon of increased transformation at low cell density and to confirm some of the assumptions concerning the culture conditions for C3H-10T 1/2 cells about to be used in experiments. In particular, two hypotheses were tested: (1) cell density does play a role in x-ray transformation frequency, and (2) freshly confluent cells that are trypsinized and replated approximately 24 hours prior to x-ray treatment are an asynchronous, exponential growing population of single cells at the time of x-irradiation.

31267 (DOE/EV/04733—T1, pp 168-185) **Radiosensitizing and cytotoxic properties of several hypoxiamediated drugs.** Astor, M.; Hall, E.J. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

Many strategies have been suggested to overcome the resistance of hypoxic cells to x- and γ-rays, the most recent of which involves the use of electron affinic agents which mimic oxygen by differentially sensitizing hypoxic cells to the lethal effect of x-rays. Two of these compounds, Metronidazole and Misonidazole, have already entered phase III clinical trials; however, the dose of Misonidazole that can be used is limited due to the appearance of neurotoxicity. Consequently, attention has focussed on the need to synthesize or identify compounds with equal or greater effectiveness but at the same time exhibiting less troublesome side effects. This paper describes experiments with mammalian cells in vitro to compare the radiosensitizing and cytotoxic properties of five newly synthesized hypoxia-mediated drugs with the current drug in use, Misonidazole.

31268 (DOE/EV/04733—T1, pp 210-220) **Studies with encapsulated ^{125}I sources: determination of the relative biological effectiveness using cultured mammalian cells in unfed plateau phase.** Freeman, M.L.; Goldhagen, P.; Sierra, E.; Hall, E.J. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

In the last ten years the use of encapsulated Iodine-125 in interstitial brachytherapy has gained increasing popularity compared to such radioisotopes as Radon-222 or Iridium-192. Theoretical considerations based on microdosimetric measurements suggest that the relative biological effectiveness (RBE) of 28.3 keV photons should have a value of approximately 2.0. The purpose of this study was to determine the effectiveness of Iodine-125 irradiation relative to Cesium-137 irradiation using cell killing of plateau phase cells as an endpoint. These cultures were used because they provide a convenient in vitro model for determining the radiation response of G_0 cells. Because the irradiation periods extended as long as 96 hours, unfed plateau phase cultures were used in order to reduce the number of cycling cells and to minimize perturbations.

31269 (DOE/EV/04733—T1, pp 221-231) **Studies with encapsulated ^{125}I sources: determination of the relative biological effectiveness using cultured mammalian cells in exponential growth.** Freeman, M.L.; Goldhagen, P.; Sierra, E.; Hall, E.J. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

One of the factors which may influence the relative biological effectiveness of Iodine is the relationship between dose-rate and RBE. For this reason, the present study was undertaken to measure the RBE of encapsulated Iodine-125 relative to Cesium-137 at low dose rates using exponentially growing mammalian cells.

31270 (DOE/EV/04733—T1, pp 232-249) **Studies on the induction of chromosomal aberrations and cell cycle progression effects of random and associated charged particles.** Geard, C.R. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

The finding of a linear-quadratic, dose-response relation for two-break aberrations after low LET radiation, implies that initially interactive breaks are induced along individual particle tracks at comparatively low efficiency and as dose increases tracks become closer together and hence lesions induced by independent tracks can interact with each other. As dose continues to increase so tracks become ever closer, breaks ever more likely to interact, and hence the quadratic component dominates. The relationship between interaction distance and aberration formation can be made using controlled associated charged particles. The unique radiation configurations used are closely associated dyads (pairs) or triads (triplets) of energetic ions that result when molecular ions are directed under vacuum to a thin foil, in which the molecules dissociate and the resultant atomic ions separate by multiple scattering. They then traverse cells growing on the obverse face of the foil. Production of chromosomal aberrations which originate from interaction between two spatially distinct foci should be enhanced as the particles lose energy and induce lesions along their closely associated paths. Any increase in aberration yield over that for a similar fluence of random particles is then due to interaction between lesions induced along individual particle tracks.

31271 (DOE/EV/04733—T1, pp 250-261) **X-ray induced delays in cell progression and chromosomal aberrations production in Tradescantia clone 02 root meristems.** Geard, C.R. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

Tradescantia clone 02 was developed to facilitate the quantitative demonstration of localized phenotypic changes in petal and/or stamen hair color following ionizing radiation and other environmental mutagens. The induction of pink somatic mutations in stamen hairs proved to be an experimental system particularly suitable for the study of effects of low doses of ionizing radiations. In particular predictions made on microdosimetric grounds were testable with this system, thus it has been of considerable utility in this laboratory. Other influences of radation include interference with

the normal progression of cells through the mitotic cycle and the induction of chromosomal aberrations. Early experiments with Tradescantia microspores provided a substantive body of data on chromosomal aberrations and contributed largely to the development of quantitative formalisms for the action of ionizing radiation.

31272 (DOE/EV/04733—T1, pp 274-280) **Morphometric studies with attached mouse C3H/10T 1/2 cells.** Geard, C.R.; Harding, T. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

Studies of in vitro transformation using the Syrian hamster embryo cell system and the mouse C3H/10T 1/2 cell system form an integral part of this laboratory's activities. As part of the studies with the mouse cell line we have monitored the behavior of these cells in culture in order to ascertain those variables which might influence the expression of transformation. The study of transformed cells versus normal cells could lead to insight into an earlier definition of transformation that the clonal morphological change currently in use. This present report details the changes in cellular morphology with time in culture of normal mouse C3H/10T 1/2 cells from early passages (9 to 13) and x-ray transformed cells which have been maintained in culture for three years.

31273 (DOE/EV/04733—T1, pp 281-284) **Effects of protective and sensitizing agents in the molecular ion experiment.** Bird, R.P. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

The effects of chemicals known to alter cellular radiosensitivity were evaluated in the molecular ion experiment. The radioprotective agent, cysteamine, and the radiosensitizing agent, bromodeoxyuridine (BUdR) incorporated into DNA, were used. A third chemical, the protective agent dimethyl sulfoxide (DMSO) was considered. However, for concentrations of DMSO with significant radiation protection, cell morphology and attachment to the growth surface were altered so that it was of dubious usefulness under stringent requirements of the molecular ion experiment. Chinese hamster V79 cells were grown using standard procedures. Hydroxyurea was added to the medium of exponentially growing cultures.

31274 (DOE/EV/04733—T1, pp 285-288) **Proton penetration experiments: revised evaluation.** Bird, R.P. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

In a previous Annual Report (COO-4733-1) results were presented for cell survival experiments with monolayers of cells irradiated with low-energy protons, the energy of which was varied so as to vary the proton range for penetrations to different cell depths. Since that report, dosimetry corrections have been made which alter the resultant picture of cellular sensitivity. The techniques of cell culturing, synchronizing, and irradiating were previously described (Annual Reports, COO-3243-3 through -6). Data were obtained in two ways: irradiation of late S phase Chinese hamster V79 cells with varied fluences of protons of fixed energy or irradition of late S cells with protons of varied energy at a fixed fluence.

31275 (DOE/EV/04733—T1, pp 289-291) **Molecular ion experiment at Los Alamos Scientific Laboratory.** Bird, R.P. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

The Van de Graaff facility at Los Alamos Scientific Laboratory (LASL) with its 8 MV, single Van de Graaff accelerator was used to accelerate diatomic deuterium to high energies to achieve smaller average separations for spatially correlated ions passng through a given Mylar foil thickness. An LET value of between 16 and 18 keV/μm was anticipated with deuteron pairs separated by as little as an average of 40 nm for 4 μm Mylar foils. With such close separations, information relevant to the analytical treatment for the molecular ion experiment was expected. Experiments were conducted using Chinese hamster V79 cells synchronized by hydroxyurea treatment to be in late S phase. Survival curves were obtained using single deuterons of the LET of interest (18 keV/μm) and for deuterons with LET value nominally doubled (38 keV/μm). Survival ratios at several doses were measured for three Mylar thicknesses (4, 6, and 10 μm).

31276 **(PNL—3280) General safety assessment document for PNL-managed nonreactor nuclear facilities.** Backman, G.E.; McMurray, B.J.; Nisick, N.P.; Richey, C.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1981. Contract AC06-76RL01830. 123p. NTIS, PC A06/MF A01. Order Number DE81026321.

Included in this document are brief descriptions of Pacific Northwest Laboratory (PNL)-managed nonreactor nuclear facilities and delineation of the administrative controls, responsibilities, nuclear safety limits, support organizations, audit programs, training programs, emergency preparedness plans, radiation protection policy, and other operational requirements or vehicles that have been adopted to ensure the safety of each facility and/or the collective safety of all facilities. In addition, currently existing evaluations of public and employee risk from hypothetical accidents are summarized. Many PNL managed facilities contain quantities of radionuclides so small that potential accidents involving these radionuclides would have insignificant environmental effects. Also, potential accidents internal to these facilities, involving radioactive materials, would have only minor radiation consequences. These facilities have been grouped together. The available safety evaluations and the many years of good safety experience indicate that PNL-managed facilities are being and can continue to be operated without undue risk to the public or employees. The evaluations reported in this document also show that the intent of the environmental, safety and health program requirements of ERDA Manual Chapter 0531 is being met by PNL's overall safety policies and practices. However, compliance with the safety analysis or assessment documentation requirements has not been fully accomplished.

31277 **(UCD—34P151-4) Genetic studies of radiation-sensitive mutants of yeast. Final report.** Snow, S.R. (California Univ., Davis (USA). Dept. of Genetics). Feb 1972. Contract AM03-76SF00034. 26p. NTIS, PC A03/MF A01. Order Number DE81027373.

This report summarizes progress in efforts to isolate radiosensitive mutants of Saccharomyces cerevisiae for studying mechanisms of radiosensitivity, effect of such mutations on genetic recombination, and the relation to the DNA repair pathways. (PSB)

31278 **Hydroxyurea revisited: a decade of clinical effects studies.** Sinclair, W.K. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *International Journal of Radiation Oncology, Biology and Physics ;* 7: No. 5, 631-637(May 1981).

Over a decade ago hydroxyurea was shown to selectively kill cells in the S phase in a proliferating cell population and to block cells at the G_1-S border. Consequently, blocked cells became sensitized to irradiation and were further sensitized when the drug was present after exposure. In the ensuing decade, many in vivo studies on hydroxyurea have confirmed that the main properties of hydroxyurea identified in the dish are also evident in vivo. During a period of about ten years, a considerable number of clinical studies have been performed, the results of which have been mixed, ranging from indeterminate to encouraging, depending to some extent on the site treated and whether careful randomized studies were done. The question arises whether the clinical studies have represented adequate tests, by laboratory standards, of the likely effectiveness of the drug in clinical circumstances. The clinical studies with hydroxyurea have been examined in this light, since the results might also bear on the use of many other such agents in combination therapy. This examination revealed that no attempts have been made to determine the concentration of hydroxyurea in the tumor and other relevant tissues as a function of time or to assess the cell kinetic features of the tumor and thus estimate the appropriate dose regimen. It would seem that a wide gap still exists between laboratory research and clinical application.

31279 **(JPRS—78499,** pp 93-96) **Effect on mouse skin of radiation differing in linear energy transfer.** Savchenko, N.Ya.; Portman, A.I.; Ryzhov, N.I. May 1981. Translated from Kosm. Biol. Aviakosmicheskaya Med.; 15: No. 3, 63-65(May 1981). NTIS.

In USSR report: space biology and aerospace medicine.

Experiments were carried out to measure the time and severity of the radiation reaction of the skin of mice exposed to X- and gamma-radiations, protons with energies of 645 and 50 MeV as well as accelerated helium ions at doses of 200 to 4000 rad. It was found that relative biological effectiveness coefficients of 645 and 50 MeV protons were 1.0 and those of helium ions were 1.3 for the skin reaction at early and late stages of observation. No significant difference in time of manifestation of radiation-induced skin lesions related to radiations with various LET was detected.

31280 **Radiation chemistry of amino acids, peptides and proteins in relation to the radiation sterilization of high-protein foods.** Garrison, W.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Radiation Effects ;* **54**: No. 1-2, 29-39(Jan 1981).

An important source of information on the question of whether or not toxic or other deleterious substances are formed in the radiation sterilization of foods is the chemical study of reaction products and reaction mechanisms in the radiolysis of individual food components. The present evaluation of the radiation chemistry of amino acids, peptides and proteins outlines the various radiation-induced processes which lead to amino acid degradation and to the synthesis of amino acid derivatives of higher molecular weight. Among the latter are the α,α′-diamino dicarboxylic acids which are formed as major products in the radiolysis of peptides both in aqueous solution and in the solid state. The α,α′-diamino acids are of particular interest as irradiation products because they represent a class of compounds not normally encountered in plant and animal protein sources. Such compounds have, however, been isolated from certain types of bacteria and bacterial products. All of the available data strongly suggest that the α,α′-diamino acids are produced in significant yield in the radiation sterilization of high protein foods. The importance of initiating extensive chemical and biological studies of these and of other high molecular weight products in irradiated food is emphasised.

31281 **Reassessment of radiation hazards: can health physicists keep up.** Cohen, J.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Health Physics ;* **39**: No. 6, 1002-1003(Dec 1980).

Letter to the editor.

31282 **Statistical analysis of a Los Alamos Scientific Laboratory study of plutonium in U.S. autopsy tissue.** Fox, T.; Tietjen, G.L.; McInroy, J.F. (Los Alamos Scientific Lab., NM (USA)). *Health Physics ;* **39**: No. 6, 877-892(Dec 1980).

The autopsy Tissue Program at the Los Alamos Scientific Laboratory was begun in 1959. To date, tissues from 900 or more persons in 7 geographic regions throughout the U.S. have been collected and analyzed for plutonium content. The tissues generally consist of lung, liver, kidney, lymph node, bone, spleen, thyroid and gonadal tissues for each individual. The present objective of the program is to determine the level of plutonium in human tissues due solely to fall-out from weapons testing. The baseline thus established is to be used to evaluate future changes. Geographical comparisons are made, but require adjustment because of outliers, and time and age trends present in the data.

31283 **Placental transfer of americium and plutonium in mice.** Weiss, J.F.; Walburg, H.E. (Comparative Animal Research Lab., Oak Ridge, TN (USA)); McDowell, W.J. (Oak Ridge National Lab., TN (USA)). *Health Physics ;* **39**: No. 6, 903-911(Dec 1980).

Actinide element release to the environment and subsequent transfer through food chains to pregnant women may present a radiation hazard to fetuses in utero. To measure americium incorporation, four groups of pregnant mice were intravenously dosed with four concentrations of ^{243}Am citrate in late pregnancy. Concentrations of ^{243}Am in fetuses, placentas, and maternal femur, liver, carcass and pelt were determined 48 hr after injection. Doses were chosen so that the number of atoms of ^{243}Am in each injected dose was equal to the number of atoms of ^{239}Pu used in an earlier study of transplacental movement. Results indicate that, atom for atom, americium is incorporated into fetal tissue in lesser amounts (10-25 times) than is plutonium when intravenously administered to pregnant mice in equal atom amounts. Tissue analyses indicated that, at low dose levels, the average fraction of the dose incorporated into the fetuses decreased as the dose to the pregnant mouse was increased. A similar pattern was noted for placentas and maternal femurs. Data indicate that one must make extrapolations from low dose data only to make reasonable and realistic estimates of the transplacental movement and fetal incorporation of environmental levels of actinide elements in man and other species.

31284 **Liposomal encapsulated Zn-DTPA for removing intracellular ^{169}Yb.** Blank, M.L.; Cress, E.A.; Byrd, B.L.; Washburn, L.C.; Snyder, F. (Oak Ridge Associated Universities, Inc., TN (USA). Medical and Health Science Div.). *Health Physics ;* **39**: No. 6, 913-920(Dec 1980).

Multilamellar liposomes possessing neutral positive or negative charges were tested for their capacity to encapsulate sodium ethylenediaminetetraacetate (EDTA) and for their selectivity in depositing in specific tissues after being injected into rats. Negative-charged liposomes had the greatest trapping efficiency over a wide range of lipid-to-aqueous phase ratios. In contrast, except for lung, liposomal charge had no significant effect on the tissue distribution of encapsulated EDTA; liver and spleen exhibited the highest uptake with all preparations. The proportion of encapsulated EDTA taken up by the liver decreased as the amount of injected liposomes was increased. Free zinc diethylenetriaminepentaacetate (Zn-DTPA) and multilamellar liposomes containing entrapped Zn-DTPA were administered to rats that had been injected with ^{169}Yb-citrate 24 hr earlier. At doses of 14 mg Zn-DTPA per kg body weight, both free Zn-DPTA and the liposomal-bound Zn-DTPA caused increased removal of ^{169}Yb from the animals. However, treatment with the liposomal Zn-DTPA caused significantly more of the ^{169}Yb to be removed than did the free Zn-DTPA treatment by itself. Our data indicate that lipophilic forms of chelators can effectively increase the removal rates of heavy metal contamination in tissues.

31285 **Urinary excretion of curium by two cases sustaining a subcutaneous intake of $Cm(NO_3)_3$.** Parkinson, W.W. Jr.; Henley, L.C.; Nestor, C.W. Jr. (Oak Ridge National Lab., TN (USA)). *Health Physics ;* **39**: No. 6, 977-980(Dec 1980).

The excretion history is presented of two male employees who sustained uptakes of acidic solutions of $^{244}Cm(NO_3)_3$, one via a puncture wound to the finger and the other through skin via acid burning by the solution. Although low-level, short-term excretion of this nature is a very inaccurate source from which to derive excretion and retention functions, it may serve as a base with which excretion functions from animals can be compared. Consequently, an effort was made to develop equations which would be applicable to curium excretion and which would give approximate values of systemic uptakes of these and future cases.

31286 **Photoenzyme probes of photodamage to cells and cellular DNA.** Sutherland, B.M. (Brookhaven National Lab., Upton, NY). *Annals of the New York Academy of Sciences ;* **346**: 389-397(17 Jun 1980).

Development of the use of photoenzyme probes depends on two major factors. The first is the development of a method for the insertion of exogenous enzymes into intact cells. The Sendai and PEG techniques show great promise here. The second is the isolation and characterization of enzymes specific for different kinds of damage in DNA. Several of these enzymes have been isolated, or their activities reported: one enzyme that nicks at apurinic sites in DNA, one that removes uracil from DNA, one that recognizes nondimer damage in uv-irradiated DNA and one that is specific for DNA damage induced by ionizing radiation. Certainly, many others are being studied at present or will be described in the near future. The development of a whole battery of protein probes for examining small numbers of specific lesions in DNA and determining their biological importance will open new vistas to understanding chemical and radiation damage to biological systems.

31287 **Mammography at reduced doses: present performance and future possibilities.** Muntz, E.P.; Wilkinson, E.; George, F.W. (Univ. of Southern California, Los Angeles). *AJR, American Journal of Roentgenology ;* **134**: No. 4, 741-747(Apr 1980).

Reduced dose mammography is assessed with the aid of very recent work. It is concluded that there are technical and clini-

cal reasons for believing that the reduced dose systems and their interpreters should perform more effectively than their predecessors. Review of known technologic achievements suggests a possible 6 to 7 reduction factor from present screen-film mammography dose levels without sacficifing image quality. Reasonable estimates of representative doses presently achieved by both xeroradiography and screen-film systems are given. The screen-film value is about 3 times higher than some previous.

31288 **Role of mobile passenger lymphocytes in the rejection of renal and cardiac allografts in the rat. A passenger lymphocyte-mediated graft-versus-host reaction amplifies the host response.** van Vrieshilfgaarde, R.; Hermans, P.; Terpstra, J.L.; van Breda Viresman, P.J. (Univ. Hospital, Leiden, Netherlands). *Transplantation ;* **29**: No. 3, 209-213(Mar 1980).

It is demonstrated that passenger lymphocytes migrate out of rat renal allografts into host spleens in a radioresistant fashion. These mobile passenger lymphocytes within BN kidney and heart transplants are immunocompetent, since they elicit a graft-versus-host (GVH) reaction in the spleens of (LEW x BN)F2 hybrid hosts. The greater GVH reaction in (LEW x BN)F1 recipients of BN kidneys reflects the greater number of mobile passenger lymphocytes in the kidney when compared to the heart. The mobile passenger lymphocytes within BN renal allografts also cause a proliferative response in the spleens of the LEW hosts as well as an accelerated rejection of BN renal allografts when compared to BN cardiac allografts, for the differences between BN kidney and heart, both in terms of splenomegaly elicited in LEW as well as tempo of rejection, are abolished by total body x-irradiation of the donor with 900 rad. Results indicate that a mobile passenger lymphocyte mediated GVH reaction in the central lymphoid organs of the host augments the host response to allogenic kidneys and contributes materially to first-set renal allograft rejection; this GVH reaction on the other hand is not conspicuously present in LEW recipients of BN cardiac allografts and has therefore little effect on first-set cardiac allograft rejection.

31289 **Hyperprolactinemia from radiation-induced hypothalamic hypopituitarism.** Corkill, G.; Hanson, F.W.; Gold, E.M.; White, V.A. (Univ. of California, Davis). *Surgican Neurology (Tryon, N.C.) ;* **13**: No. 1, 47-48(Jan 1980).

In 1975 Samaan et al., described the effects of radiation damage of the hypothalamus in 15 patients with head and neck cancer. Shalet et al., in 1977 described endocrine morbidity in adults who as children had been irradiated for brain tumors. This report describes instances of hyperprolactinemia and associated hypothalamic, pituitary, and thyroid dysfunction following irradiation of a young adult female for brain neoplasia.

31290 **RAD52 gene is required for homothallic interconversion of mating types and spontaneous mitotic recombination in yeast.** Malone, R.E.; Esposito, R.E. (Univ. of Chicago, IL). *Proceedings of the National Academy of Sciences of the United States of America ;* **77**: No. 1, 503-507(Jan 1980).

The RAD52-1 mutation prevents homothallic mating type interconversion and reduces mitotic recombination in yeast. It has been previously reported that RAD52-1 abolishes meiotic recombination. These data suggest either that a generalized recombination function(s) is required for mating type switching or that generalized recombination and specific homothallic functions are jointly controlled by the RAD52 gene. The RAD52-1 mutation affects the interconversion of the two yeast mating types (a and alpha) differently, suggesting that the interconversion process is not equivalent for both mating types. This type of asymmetry is not predicted by current models of homothallic switching.

31291 **Whole-mammal mutagenicity tests: Evaluation of five methods.** Russell, L.B. (Oak Ridge National Lab., TN (USA). Biology Div.); Matter, B.E. (Sandoz A.G., Basel (Switzerland). Pharmazeutische Abt.). *Mutation Research ;* **75**: No. 3, 279-302(1980).

Four methods most commonly employed in whole-mammal germ-line mutagenicity tests as well as an in vivo somatic prescreen are summarized. Genetic basis, historical background, description of the test, limitations, and strengths are presented for each of the five systems.

31292 **Damages to DNA that result in neoplastic transformation.** Setlow, R.B. (Brookhaven National Lab., Upton, NY). pp 99-108 of Advances in biological and medical physics, Volume 17. Lawrence, J.H. (ed.). New York, NY; Academic Press, Inc. (1980).

The determination of the probability that particular changes in DNA will give rise to tumors is a difficult one and has been estimated only for uv irradiation. Nevertheless, such determinations are important if we are to evaluate the long-range hazards of environmental agents. There are no strict rules as to how to solve this general problem, but a lot of ingenuity will have to go into the solutions.

31293 **(AEC-tr—5630) Atlas on the pathological anatomy of acute radiation sickness in experiment.** Funshtein, L.V. (Department of Energy, Washington, DC (USA)). 1961. Translation of a publication of the State Publishing House for Medical Literature, Leningrad, 1961. 222p. NTIS, PC A10/MF A01. Order Number DE81029069.

A morphological study of radiation sickness produced in experimental animals by both external and internal irradiation is presented. The morphological findings have been interpreted in terms of their clinical signifinance. (ACR)

5602 Thermal Effects

REFER ALSO TO CITATION(S) 30532

31294 **(EPRI-EA—1897) Pathogenic amoebae in power-plant cooling lakes. Final report.** Tyndall, R.L.; Willaert, E.; Stevens, A.R. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA); Veterans Administration Hospital, Gainesville, FL (USA)). Jun 1981. Contract W-7405-ENG-26. 49p. NTIS, PC A03/MF A01. Order Number DE81024004.

Cooling waters and associated algae and sediments from four northern and four southern/western electric power plants were tested for the presence of pathogenic amoebae. Unheated control waters and algae/sediments from four northern and five southern/western sites were also tested. When comparing results from the test versus control sites, a significantly higher proportion ($P \leqq 0.05$) of the samples from the test sites were positive for thermophilic amoeba, thermophilic Naegleria and pathogenic Naegleria. The difference in number of samples positive for thermophilic Naegleria between heated and unheated waters, however, was attributable predominantly to the northern waters and algae/sediments. While two of four northern test sites yielded pathogenic Naegleria, seven of the eight isolates were obtained from one site. Seasonality effects relative to the isolation of the pathogen were also noted at this site. One pathogen was isolated from a southwestern test site. Pathogens were not isolated from any control sites. Some of the pathogenic isolates were analyzed serologically and classified as pathogenic Naegleria fowleri. Salinity, pH, conductivity, and bacteriological profiles did not obviously correlate with the presence or absence of pathogenic Naegleria. While thermal addition was significantly associated with the presence of thermophilic Naegleria ($P \leqq 0.05$), the data implicate other as yet undefined parameters associated with the presence of the pathogenic thermophile. Until further delineation of these parameters is effected, generalizations cannot be made concerning the effect of thermal impact on the growth of pathogenic amoeba in a particular cooling system.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 29963, 30680, 31188, 31200, 31248, 31250

31295 **(ANL/EES-TM—142) Solid and hazardous energy wastes: synfuels. I. Review of research activities.** Fradkin, L.; Surles, T.; DeCarlo, V. (Argonne National Lab., IL (USA)). May 1981. Contract W-31-109-ENG-38. 164p. NTIS, PC A08/MF A01. Order Number DE81028503.

Current chemical and biological research sponsored by the Department of Energy (DOE) and the Environmental Protection Agency (EPA) on solid, liquid, and gaseous waste streams from

coal-conversion and oil-shale technologies is summarized. Brief descriptions, including the objectives, current activities, and future plans (if any), of ongoing projects were obtained from the principal investigators, where possible, or from current publications, progress reports, or scope-of-work sheets from DOE and EPA laboratories. References to publications that have resulted from the various research projects are included where applicable. Additional references to work on hazardous and solid synfuel waste are included in the appendixes, drawn from computerized bibliographic searches of Chemical Abstracts and the National Technical Information Service (NTIS). Appendix I contains information found in the NTIS search from 1974 to 1980, which includes the title, author(s), place of investigation, NTIS ordering number, date of publication, and the actual abstracts. Appendix II contains information found in the Chemical Abstracts search from 1973 to 1980, which includes the title; author(s); journal title, volume, and number; chemical abstracts numbers; descriptors and identifiers based on the given title and/or abstract; and date of publication.

31296 (DOE/EV/02792—T1) **Molecular mechanisms of the epithelial transport of toxic metal ions, particularly mercury, cadmium, lead, arsenic, zinc and copper. Comprehensive progress report, January 1, 1979-July 31, 1981.** Wasserman, R.H.; Fullmer, C.S. (Cornell Univ., Ithaca, NY (USA)). 1981. Contract AS02-76EV02792. 72p. NTIS, PC A04/MF A01. Order Number DE81029091.

Investigations have been continued to elucidate the mode of transepithelial transport of potentially toxic metal ions across the gastrointestinal tract, as well as their interactions with biological processes and other metal ions. Primary attention for this report period has been given to lead, cadmium and zinc.

31297 (DOE/EV/03140—T2) **Toxicology and metabolism of nickel compounds. Progress report, December 1, 1980-November 30, 1981.** Sunderman, F.W. Jr. (Connecticut Univ., Farmington (USA). School of Medicine). 31 Jul 1981. Contract AS02-76EV03140. 16p. NTIS, PC A02/MF A01. Order Number DE81028924.

The toxicology and metabolism of nickel compounds (e.g., $NiCl_2$, Ni_3S_2 and $Ni(CO)_4$) were investigated in rats. A provisional reference method for analysis of nickel in whole blood by electrothermal atomic absorption spectrometry was developed. Five macromolecular ^{63}Ni-binding constituents in rat kidney cytosol were partially characterized. A spectrophotometric assay for N-acetyl-β-D-glucosaminidase (NAG) activity in urine was developed, and the NAG assay was applied to investigate nickel nephropathy in rats. The time-course, dose-response, and organ specificity of Ni(II)-induction of heme oxygenase activity in rats was elucidated. Intrarenal injection of Ni_3S_2 in rats was demonstrated to result in renal glomerulomegaly and mesangial hyperplasia, sialyl hyperplasia, and generalized arteriosclerosis. The dissolution rates of 17 nickel compounds were determined in water, rat serum and renal cytosol. NiTc, NiSb and $NiAs_6$ were discovered to be carcinogenic following intramuscular injection in Fischer rats. Nickel concentrations were surveyed in serum and urine of workers in two shipyards. (ACR)

31298 (DOE/EV/04733—T1, pp 144-148) **Comparison of the oncogenic potential of several chemotherapeutic agents.** Miller, R.C.; Hall, E.J.; Osmak, R.S. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

Several chemotherapeutic drugs that have been routinely used in cancer treatment were tested for their carcinogenic potential. Two antitumor antibiotics (adriamycin and vincristine), an alkalating agent (melphalan), 5-azacytidine and the bifunctional agent cis-platinum that mimics alkylating agents and/or binds Oxygen-6 or Nitrogen-7 atoms of quanine were tested. Cell killing and cancer induction was assessed using in vitro transformation system. C3H/10T 1/2 cells, while normally exhibiting contact inhibition, can undergo transformation from normal contact inhibited cells to tumorgenic cells when exposed to chemical carcinogens. These cells have been used in the past by this laboratory to study oncogenic transformation of cells exposed to ionizing radiation and electron affinic compounds that sensitize hypoxic cells to x-rays. The endpoints of cell killing and oncogenic transformation presented here give an estimate of the carcinogenic potential of these agents.

31299 (DOE/EV/04733—T1, pp 186-195) **Hyperthermia and chemotherapy agent.** Roizin-Towle, L.; Hall, E.J. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

The use of chemotherapeutic agents for the treatment of cancer dates back to the late 19th century, but the modern era of chemotherapy drugs was ushered in during the 1940's with the development of the polyfunctional alkylating agent. Since then, numerous classes of drugs have evolved and the combined use of antineoplastic agents with other treatment modalities such as radiation or heat, remains a large relatively unexplored area. This approach, combining local hyperthermia with chemotherapy agents affords a measure of targeting and selective toxicity not previously available for drugs. In this paper, the effects of adriamycin, bleomycin and cis-platinum are examined. The adjuvant use of heat may also reverse the resistance of hypoxic cells noted for some chemotherapy agents.

31300 (DOE/EV/04733—T1, pp 196-209) **Misonidazole pretreatment enhances the cytotoxicity of antineoplastic agents.** Roizin-Towle, L.A.; Hall, E.J. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

Over the years, a substantial effort has been devoted to developing methods to overcome the problem of hypoxic cells in radiotherapy, the most recent of which involves the use of heterocyclic nitro compounds that mimic oxygen and interact with radiation to increase specifically the sensitivity of hypoxic cells, while not affecting the response of normal aerated cells. A number of compounds have been identified and studied in experimental systems and one of them, Misonidazole, preferentially cytotoxic to cells deficient in oxygen. The suggestion that the toxicity shown towards hypoxic cells by electron affinic agents might be valuable in combination with antineoplastic agents was based on the premise that they would act in a way that was complementary, but independent, i.e., that the hypoxic mediated drugs would kill the hypoxic cells spared by the conventional chemotherapy agents. There is now good evidence, however, of a direct interaction between electron affinic compounds and other antineoplastic agents. The present investigation extends the range of chemotherapy agents shown to interact with Misonidazole to include Bleomycin, and in particular addresses the question of the mechanism of the interaction.

31301 (DOE/EV/10328—T1) **Molecular biology of environmental aromatic hydrocarbons. Progress report, January 1-June 31, 1981.** Weiss, S.B. (Chicago Univ., IL (USA)). Jul 1981. Contract AC02-80EV10328. 12p. NTIS, PC A02/MF A01. Order Number DE81029033.

We have been examining the molecular biology of activated polycyclic aromatic hydrocarbons (PAH) in several different ways, using different biochemical systems. The projects involving these systems are as follows: (I) The binding of benzo(a)pyrene-7,8-dihydrodiol to phage DNA; (II) the binding of PAH-epoxide derivatives to single- and double-stranded 0X174 DNA and its effect on viral DNA infectivity; (III) the fate of benzo(a)pyrene adducts on SV40 DNA in infected monkey kidney cells; (IV) the effect of PAH derivatives on RNA transcription; and (V) the effects of anti-BPDE on tRNA aminoacyl charging and protein synthesis.

31302 (DP-MS—81-63) **Effect of biocides on algae and igionnaires disease bacteria. Final technical report.** Pope, D.H. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Biology). 1981. Contract AC09-76SR00001. 114p. NTIS, PC A06/MF A01. Order Number DE81028768.

Biocides currently being used in cooling tower facilities were tested for their usefulness in killing or retarding the growth of the various algae and bacteria, especially Legionnaires Disease Bacterium (LDB). Minimal effective in situ concentrations of each of the biocides were determined for the control of the algae and LDB. The optimal mode of application of the biocides was determined also. The data included here constitute, the most complete and im-

portant results obtained thus far by any research group on the effectiveness of nonchlorine type biocides in eliminating L. pneumophila from cooling systems. A more detailed outline of specific objectives proposed and accomplishments relative to each can be found in the Introduction. Specifics of methods, results, interpretation of data etc. can be found in the Chapters of this report dealing with each major portion of the study.

31303 **Chironomus tentans bioassay for testing synthetic fuel products and effluents, with data on acridine and quinoline.** Cushman, R.M.; McKamey, M.I. (Oak Ridge National Lab., TN). W-7405-ENG-26. *Bulletin of Environmental Contamination and Toxicology ;* **26**: No. 5, 601-605(May 1981).

Sensitive tests of toxicity to aquatic insects are useful for assessing the effects of potential pollutants on aquatic ecosystems. Within the last few years, research emphasis has included the toxicity of coal-related synthetic fuel products and effluents to aquatic biota. As part of an Oak Ridge National Laboratory (ORNL) program to evaluate the environmental effects of synthetic fuel products and effluents, a series of tests is being used to measure the toxicity of whole and fractionated synthetic fuel products and effluents and representative pure compounds (polycyclic aromatic hydrocarbons, phenols, and azaarenes) to aquatic organisms. Synthetic fuel materials are complex mixtures of inorganic and organic substances, including aliphatic hydrocarbons, aromatic hydrocarbons, and N-, S-, and O-substituted aromatics. By testing fractions and components of whole materials, we can begin to explain observed toxic effects and recommend further treatment to reduce toxicity. Test organisms include freshwater crustaceans (Daphnia pulex and magna), green algae (Selenastrum capricornutum), blue-green algae (Microcystis aeruginosa), snails (Physa heterostropha and Helisoma sp.), fathead minnows (Pimephales promelas), bluegill sunfish (Lepomis macrochirus), and rainbow trout (Salmo gairdneri).

31304 **Bis(methylmercuric) selenide as a reaction product from methylmercury and selenite in rabbit blood.** Naganuma, A.; Imura, N. (Kitasato Univ., Tokyo, Japan). *Research Communications in Chemical Pathology and Pharmacology ;* **27**: No. 1, 163-173(Jan 1980).

The compound formed by the reaction of methylmercury and selenite in rabbit blood was characterized. When methylmercuric chloride (10 nmol) and sodium selenite (10 nmol) were added to rabbit blood (1 ml), about 6.5 nmol of mercury and 3.2 nmol of selenium were extracted with benzene. Mercury and selenium thus transferred into benzene at the molar ratio of 2:1 were confirmed to form a single compound which was identified as bis(methylmercuric) selenide:$(CH_3HG)_2Se$. The formation of $(CH_3Hg)_2Se$ from methylmercury and selenite in blood, presumably by the participitation of glutathione (GSH), might play a role in the protective effect of selenium against methylmercury toxicity.

31305 **Effect of ethanol on the fate of mercury vapor inhaled by man.** Hursh, J.B.; Greenwood, M.R.; Clarkson, T.W.; Allen, J.; Demuth, S. (Univ. of Rochester, NY). Contract EY-76-C-02-3490. *Journal of Pharmacology and Experimental Therapeutics ;* **214**: No. 3, 520-527(1980).

Three human subjects ingested 1065 ml of beer equivalent to 65 ml of ethanol 30 min before exposure (12 to 20 min) to mercury vapor. An additional two subjects were exposed to mercury vapor without ethanol pretreatment. The results show that alcohol brings about: (1) reduced mercury retention, (2) an increase in the rapid phase of vapor loss by expiration, (3) an increased mercury storage in the liver, (4) a marked reduction in mercury uptake by the red blood cells and (5) the abolition of prompt storage of mercury by the lung. In addition, mercury vapor exposure experiments were performed by using control and ethanol-pretreated mice and rats. Sacrifice occurred at 1 hr and 3 days. The results support and extend the human data.

31306 **Comparative studies of zinc metabolism in cultured Chinese Hamster cells wth differing metallothionein-induction capacities.** Hildebrand, C.E.; Enger, M.D.; Tobey, R.A. (Los Alamos Scientific Lab., NM). *Biological Trace Element Research ;* **2**: 235-246(1980).

Previous work in our laboratory led to the isolation of a cadmium (Cd)-resistant variant (Cd/sup r/2C10) of the line CHO Chinese Hamster cell having a 10-fold greater resistance to the cytotoxic action of Cd^{2+} compared with the CHO cell. Evidence that Cd^{2+} behaves as an analog of the essential trace metal, Zn^{2+}, especially as an inducer of MT synthesis, suggested that the Cd/sup r/ and CHO cell types could be employed to investigate cellular Zn^{2+} metabolism. In the present study, measurements were made to compare CHO and Cd/sup r/ cell types for (a) growth as a function of the level of $ZnCl_2$ added to the culture medium, (b) uptake and subcellular distribution of Zn^{2+}, and (c) capacity to induce MT synthesis. These findings suggest that (a) the CHO and Cd/sup r/ cell systems will be useful in further studies of cellular Zn^{2+} metabolism, especially in comparisons of Zn^{2+} metabolism in the presence and absence of induction of the Zn^{2+}-sequestering MT and (b) a relationship exists between cellular capacity to induce MT synthesis and capacity for cellular Zn^{2+} uptake.

31307 **Carcinogenicity and anticarcinogenicity of metal compounds.** Sunderman, F.W. Jr. (Univ. of Connecticut, Farmington). Contract AC02-76EV03140. pp 165-192 of Environmental carcinogenesis. Occurrence risk evaluation and mechanisms: proceedings. Emmelot, P.; Kriek, E. (eds.). Amsterdam, Netherlands; Elsevier/North-Holland Biomedical Press (1979).

From International conference on environmental carcinogenesis; Amsterdam, Netherlands (May 1979).

Prior to World War II, six pioneering studies laid the foundations for present knowledge of metal carcinogenesis. Hutchinson reported in 1887 that iatrogenic arsenicalism from chronic ingestion of Fowler's solution caused dermal keratoses and ultimately induced skin cancers. Michalowski discovered in 1926 that intratesticular injection of $ZnSO_4$ produced testicular teratomas in roosters. This was the first experimental system for metal carcinogenesis. Lehmann observed in 1932 that chromate workers had increased incidence of lung cancer, and Bridge noted in 1933 that Ni refinery workers were predisposed to sinonasal cancer. Bagg showed in 1936 that hormonal stimulation of testicular proliferation enhanced roosters' susceptibility to teratomas after intratesticular injection of Zn salts. Vollmann reported in 1938 that intraosseous injection of Co and Cr dusts caused osteosarcomas in rabbits. During the past 40 years, an extensive scientific literature on metal carcinogenesis has evolved, which has been summarized by Furst, Hernberg, and Sunderman.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 30542

31308 **(DOE/ET/29078—T1) Tissue interaction with nonionizing electromagnetic fields. Final report.** Adey, W.R.; Bawin, S.M.; Lawrence, A.F.; Lin-Liu, S.; Luben, R.A.; Lundak, R.L.; Sagan, P.M.; Sheppard, A.R. (Veterans Administration Hospital, Loma Linda, CA (USA); California Univ., Riverside (USA)). Feb 1981. Contract AT01-79ET29078. 174p. NTIS, PC A08/MF A01. Order Number DE81027654.

Studies of the effects of environmental low frequency electromagnetic fields on isolated cellular systems and tissue preparations derived from brain, bone, blood, and pancreas are reported. Behavioral effects of 60 Hz fields were examined in monkeys. Bioeffects of low level microwave fields modulated at 60 Hz and other ELF frequencies were also examined. Findings in the present studies emphasize a key role for cell membrane surfaces in detecting ELF environmental fields. Two broad groups of exposure techniques have been utilized. In the ELF spectrum, 60 Hz environmental fields were imposed on monkeys during behavioral task performance. Field intensities from 50 to 1000 V/m were tested in different experiments. The monkeys were exposed to a horizontal electric field. In tissue and cell culture preparations, ELF electric fields were generated by passing current between electrodes in the solutions bathing the tissue. Tissue and cell preparations were also tested with low frequency, pulsed magnetic fields by placing the biological preparation inside Helmholtz coils. For ELF dosimetry measurements in tissue preparations, electric gradients were measured directly in relation to specific axes of tissue and cell preparations. Exposures to ELF modulated 450 MHz microwave fields were conducted in two different systems, one uses a large anechoic

horn chamber, the other utilizes a Crawford cell, a double-tapered coaxial system.Environmental field levels and tissue components of these fields were studied collaboratively using implantable tissue probes developed by BRH. Concurrent environmental field levels were based on measurements with other BRH probes and a NARDA microwave probe system. (ERB)

31309 **(LBL—12954) Biological effects of high DC magnetic fields.** Tenforde, T.S. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 48p. NTIS, PC A03/MF A01. Order Number DE81028904.

The principal focus of the program is the analysis of magnetic field effects on physiological functions in experimental animals and selected organ and tissue systems. A major research effort has involved the use of electrical recording techniques to detect functional alterations in the cardiovascular, neural, and visual systems during the application of DC magnetic fields. These systems involve ionic conduction processes, and are therefore potentially sensitive to electrodynamic interactions with an applied magnetic field. In the specific case of the visual system, magnetic interactions could also arise through orientational effects on the magnetically anisotropic photopigment molecules within retinal photoreceptor cells. In addition to studies with potentially sensitive target tissues, an evaluation is being made of magnetic field effects on a broad range of other physiological functions in laboratory mammals, including the measurement of circadian rhythms using noninvasive recording techniques. Results of investigations of magnetic field effects on the conformation of DNA, and on the growth and development of plants and insects are also reported. Figures and tables provide a brief summary of some representative observations in each of the research areas described. No significant alterations were observed in any of the physiological parameters examined to date, with the exception of major changes that occur in the electrocardiogram during magnetic field exposure. Studies with several species of animals have provided evidence that this phenomenon is attributable to electrical potentials that are induced during pulsatile blood flow in the aorta and in other major vessels of the circulatory system.

31310 **Influence of acoustic phonons on the magnitude of energy fluctuations in DNA.** Lozansky, E.D. (Univ. of Rochester, NY); Sobell, H.M. Contract AC02-76EV03490. *Ferroelectrics ;* **30**: 169-173(1980).

It is shown that acoustic phonons can play an important role in determining the magnitude of energy fluctuations along the DNA molecule. This reflects heterogeneity in DNA flexibility associated with different stacking energies that stabilize various combinations of nucleotide sequences in its structure. Regions of DNA having greater flexibility undergo larger energy fluctuations. As a result, these regions have higher probability that conformational changes occur and this increases the rates of such kinetic processes as drug intercalation, DNA breathing and protein-DNA interactions. We discuss further biological implications of this effect here.

58 GEOSCIENCES

5802 Geophysics

REFER ALSO TO CITATION(S) 29769, 29817, 29971, 30043, 30046

31311 **(DOE/ET/46604—T1) Digitization, correction, and standardization of geophysical logs from deep boreholes of Central New York State. Final technical report.** Robinson, J.E. (Syracuse Univ., NY (USA)). Jul 1981. Contract AC97-79ET46604. 328p. NTIS, PC A15/MF A01. Order Number DE81029120.

Digitization and standardization of suitable logs are provided from wells located in the area of Central New York that had been under consideration as a possible site for the disposal of radioactive waste. Digitized logs included those with geophysical parameters that could be analyzed for formation porosity and lithology and in which the log interval was sufficient to evaluate formation parameters. Digitizing equipment was purchased, interfaced, and necessary software was written and documented. Magnetic tapes and hard copy playbacks of all digitized well logs are being forwarded to the Department of Energy repository at Battelle Memorial Institute for use in future projects.

31312 **(LBL—12336) Radiation impedance and radiation pattern of torsionally vibrating seismic sources.** Dorn, G.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 249p. NTIS, PC A11/MF A01. Order Number DE81025330.

Thesis.

During the last two decades the vibrating seismic source, or Vibroseis, has become an increasingly important tool in seismic exploration on land. A significant amount of progress has been made over that period of time in data collection, processing and analysis for vibrator surveys. There has been relatively little progress, however, toward understanding the interaction of vibrators and the earth. The work in this thesis is directed toward achieving two goals. First, an analysis is made of the interaction of a torsional vibrator and the medium to which it is bonded in terms of physical phenomena occurring in the vicinity of the baseplate. From this analysis methods are suggested for using source related measurements to determine some physical parameters of the medium on which the vibrator rests. Second, the effective penetration of signals from a torsional source is assessed. From the results obtained in these studies, and certain published results, some of the conclusions are extended to apply to vertical and horizontal vibrators. The study is conducted by calculating the radiation impedance and radiation patterns of vibrating torsional sources over plane-layered anelastic media.

31313 **(NP—1903613) Automatic digitization and processing of strong-motion accelerograms. Part I. Automatic digitization. Report No. 79-15 I.** Trifunac, M.D.; Lee, V.W. (University of Southern California, Los Angeles (USA). Dept. of Civil Engineering). Dec 1979. 259p. University of Southern California, Los Angeles. Order Number DE81903613.

This report presents the current data reduction and analysis procedures which are used in routine processing of strong-motion accelerograms at the University of Southern California. It presents recent developments and changes with respect to our first report in 1973 dealing with this subject (Trifunac and Lee, 1973). The first part of this report (Part I) describes the new hardware facility for automatic computer digitization of analog film accelerograms. This facility is now completed; it is operational and performs automatic digitization on a routine basis. Since it is capable of digitizing raw data an order of magnitude faster than the semi-automatic hand-controlled digitizers considered in our previous reports, the entire mini-computer software package for the corresponding data handling and processing has also been developed (Part II). Though the principles for baseline correction, instrument correction and spectral analysis of strong-motion accelerograms remain the same as in Trifunac and Lee (1973), it has been necessary to modify the old programs written for an IBM-type computer, to the form convenient for a mini-computer using disk operating systems.

31314 **(NP—1903614) Automatic digitization and processing of strong-motion accelerograms. Part II. Computer processing of accelerograms. Report No. 79-15 II.** Lee, V.W.; Trifunac, M.D. (University of Southern California, Los Angeles (USA). Dept. of Civil Engineering). Dec 1979. 119p. University of Southern California, Los Angeles. Order Number DE81903614.

This report presents the current data reduction and analysis procedures which are used in routine processing of strong-motion accelerograms at the University of Southern California. It presents recent developments and changes with respect to our first report in 1973 dealing with this subject (Trifunac and Lee, 1973). The first part of this report (Part I) describes the new hardware facility for automatic computer digitization of analog film accelerograms. This facility is now completed; it is operational and performs automatic digitization on a routine basis. Since it is capable of digitizing raw data an order of magnitude faster than the semi-automatic hand-controlled digitizers considered in our previous reports, the entire mini-computer software package for the corresponding data handling and processing has also been developed (Part II). Though the principles for baseline correction, instrument correction and spec-

tral analysis of strong-motion accelerograms remain the same as in Trifunac and Lee (1973), it has been necessary to modify the old programs written for an IBM-type computer, to the form convenient for a mini-computer using disk operating systems.

31315 **(UCRL—53147) Block-adaptive filtering and its application to seismic-event detection.** Clark, G.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Apr 1981. Contract W-7405-ENG-48. 209p. NTIS, PC A10/MF A01. Order Number DE81028361.

Thesis.

Block digital filtering involves the calculation of a block or finite set of filter output samples from a block of input samples. The motivation for block processing arises from computational advantages of the technique. Block filters take good advantage of parallel processing architectures, which are becoming more and more attractive with the advent of very large scale integrated (VLSI) circuits. This thesis extends the block technique to Wiener and adaptive filters, both of which are statistical filters. The key ingredient to this extension turns out to be the definition of a new performance index, block mean square error (BMSE), which combines the well known sum square error (SSE) and mean square error (MSE). A block adaptive filtering procedure is derived in which the filter coefficients are adjusted once per each output block in accordance with a generalized block least mean-square (BLMS) algorithm. Convergence properties of the BLMS algorithm are studied, including conditions for guaranteed convergence, convergence speed, and convergence accuracy. Simulation examples are given for clarity. Convergence properties of the BLMS and LMS algorithms are analyzed and compared. They are shown to be analogous, and under the proper circumstances, equivalent. The block adaptive filter was applied to the problem of detecting small seismic events in microseismic background noise. The predictor outperformed the worldwide standardized seismograph network (WWSSN) seismometers in improving signal-to-noise ratio (SNR).

31316 **Seismicity of north-central New Mexico with particular reference to the Cerrillos Earthquake of May 28, 1918.** Olsen, K.H. (Los Alamos Scientific Lab., NM). *Field Conference Guidebook (New Mexico Geological Society) ;* 65-76(1979).

The relationship between the instrumental studies of microearthquakes carried out by LASL since 1973 and the Cerrillos earthquake of 28 May 1918, which may have been the largest earthquake in the area known from historical records, is examined. (ACR)

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 29792, 29793, 30038

31317 **(SAND—81-1612) Analysis of stress drop in multistage creep experiments: predictions of exponential creep law.** Herrmann, W.; Lauson, H.S. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01. Order Number DE81029279.

Multistage creep experiments in which the stress or temperature are increased stepwise have been successfully analyzed previously using an exponential transient creep law. The analysis is generalized and implemented for an arbitrary number of stages including stress and temperature drops. Under certain conditions, the simple exponential creep law, evaluated from data for stages following increases in stress and temperature, predicts inverted transients for stages following decreases in stress or temperature. Comparisons of predictions with limited experimental data suggest that the simple exponential creep law is inadequate, and that separate hardening and recovery processes need to be modelled to handle stress or temperature drops.

31318 **Radiative thermal conductivity in obsidian and estimates of heat transfer in magma bodies.** Stein, J.; Shankland, T.J.; Nitsan, U. (Geophysics Group, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Journal of Geophysical Research ;* **86**: No. B5, 3684-3688(10 May 1981).

The optical transmission spectra of four ryholitic obsidian samples were measured in order to determine the importance of radiative heat transfer in granite magmas. The spectra, obtained in the temperature range 20-800°C, show that the radiative spectral window in these samples is limited by a charge transfer band in the UV (400 nm) and Si-O stretching overtone in the IR (4500 nm). Within this window the main obstacles to radiative transfer, in order of decreasing importance, are background scattering, a water band centered at 2800 nm, and an Fe^{2+} crystal field band at 1100 nm. Unlike crystalline silicates the absorption bands in obsidian do not broaden significantly as temperature increases. As a result, the temperature dependence of the calculated radiative thermal conductivity K/sub R/ is dominated by the T/sup β/ term. Actual values of K/sub R/ increase from 9×10^{-5} to 1×1^{-3} cal cm^{-1} s^{-1} deg^{-1} between 300° and 800°C, the high-temperature value being comparable to the lattice thermal conductivity in obsidian and a lower limit for K/sub R/ in granitic melts. As the scattering coefficient in melts is probably significantly lower than in obsidian, the radiative conductivity in active plutons is likely to be much higher. As an example, if scattering and the water band are removed from the observed spectra of the obsidian samples, calculated values of K/sub R/ could increase by a factor of 5, to about 5×10^{-3} cal cm^{-1} s^{-1} deg^{-1} at 1000°C.

5804 Geochemistry

REFER ALSO TO CITATION(S) 30002, 30003, 30004, 30402, 30403

31319 **(CONF-800718—) Third international symposium on water-rock interaction.** Campbell, A. (ed.). (Alberta Research Council, Edmonton (Canada)). 1980. 225p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE81903719.

From 3. international symposium on water-rock interaction; Edmonton, Alberta, Canada (14 Jul 1980).

Items within the scope of EDB are entered individually. (ACR)

31320 (CONF-800718—, pp 81-82) **Modelling seawater-basalt interactions in a flow-through system with a temperature gradient.** Wolery, T.J. (Lawrence Livermore Lab., CA). 1980. NTIS (US Sales Only), PC A10/MF A01.

From 3. international symposium on water-rock interaction; Edmonton, Alberta, Canada (14 Jul 1980).

Circulation of seawater through the crust at mid-ocean ridges is a major process in cooling newly formed oceanic lithosphere. This paper introduces a new simple theoretical model for seawater-basalt interaction in a flow-through system with a temperature gradient. This is an extension of the closed system theoretical models presented by Wolery (1978), which were in at least qualitative agreement with laboratory experiments reported by Seyfried (1976), Seyfried and Mottl (1977), and Seyfried and Bischoff (1979). The flow-through system is an open system that follows the evolution of a packet of fluid that moves through a medium (in cracks or pores). It may react with the medium and experience a temperature gradient. Secondary precipitates adhere to the medium. This model is here applied to estimating seawater-ocean crust interactions in one-pass systems of moderate maximum temperature on the flanks of mid-ocean ridges.

5805 Oceanography

31321 **Behavior of currents on the Washington shelf.** Hickey, B. (Univ. of Washington, Seattle). *Fishermen's News ;* No. 2, 20(May 1979).

Measurements have been made on the Washington-Oregon shelves for a number of years, with funding from the Department of Energy. The moorings of current meters typically have a subsurface float at 20 m from the surface and are thus invisible to vessels. The current measuring devices sample currents, speed and direction every 10 minutes and record the information on magnetic tape. The purpose of the experiment is to investigate the intensification of upwelling and biological activity near canyons.

64 PHYSICS RESEARCH

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 31394, 31408

31322 **(AD-A—091128) Possible influence of solar rotation on tropospheric circulation. Technical report.** Wilcox, J.M. (Stanford Univ., CA (USA). Inst. for Plasma Research). Sep 1980. Contracts N00014-76-C-0207;NAS5-24420. 20p. NTIS, PC A02/MF A01.

A large-scale structure observed in the photospheric magnetic field is carried out by the solar wind. At earth the resulting interplanetary magnetic field has polarity away from the sun for several consecutive days followed by an abrupt reversal and several days with field polarity toward the sun. This section structure appears to be related to some effects in the tropospheric circulation.

31323 **(AD-A—091811) Voyager observations of jupiter's distant magnetotail. Progress report.** Kurth, W.S.; Gurnett, D.A.; Scarf, F.L.; Poynter, R.L.; Sullivan, J.D. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Aug 1980. Contracts N00014-76-C-0016;NASA-954013. 43p. NTIS, PC A03/MF A01.

Observations of nonthermal continuum radiation by Voyager 1 and 2 at large distances from Jupiter have led to the identification of brief encounters with the Jovian magnetosphere at distances greater than 700 RJ and in directions substantially far from the Jupiter-Sun line. In addition, a number of examples of continuum radiation apparently trapped in local density depressions in the solar wind are observed. Simultaneous measurements by the Voyager plasma instrument have verified the distant magnetotail crossings and are used to correlate the occurrence of trapped continuum radiation events within solar wind density rarefractions. The Voyager observations of the distant Jovian magnetotail are compared with observations in the distant terrestrial magnetosphere and also with observations of the plasma tails of comets. One variable explanation of the observations is that the Jovian tail consists of filamentary structures, some of which extend to large distances in the pre-dawn direction. The observations of continuum radiation trapped in low-density regions of the solar wind suggest that Voyager may at times be connected to the distant tail by a low-density trough which acts as a wave guide and allows radiation from the tail to reach the spacecraft. This may provide an indirect method of detecting the tail extending more than 2 AU downstream from Jupiter.

31324 **(AD-A—091817) Adiabatic and non-adiabatic processes in thermal models of solar hard x-ray bursts. Technical report.** Emslie, A.G. (Stanford Univ., CA (USA). Inst. for Plasma Research). Sep 1980. Contracts N00014-75-C-0673;NASA-NGL-05-020-272. 23p. NTIS, PC A02/MF A01.

The processes by which the observed characteristics of the hard X-ray bremsstrahlung, emitted from a solar flare loop, are modulated, are investigated. This leads us to a set of inversion formulae, giving the behavior of physical variables in terms of observable quantities. The method is applied to recent observational data.

31325 **(LA-UR—81-2320) Radiation-hydrodynamics of HII regions and molecular clouds.** Sandford, M.T. II; Whitaker, R.W.; Klein, R.I. (Los Alamos National Lab., NM (USA); California Univ., Berkeley (USA)). 1981. Contract W-7405-ENG-36. 7p. (CONF-8106140—1). NTIS, PC A02/MF A01. Order Number DE81028696.

From IAU colloquium; Penticton, Canada (24 Jun 1981).

Two-dimensional calculations of ionization-shock fronts surrounding neutral cloud clumps reveal that a radiation-driven implosion of the clump can occur. The implosion of a cloud clump results in the formation of density enhancements that may eventually form low mass stars. The smaller globules produced may become Herbig-Haro objects, or maser sources.

31326 **(PB—81-125569) Synoptic solar magnetic field maps for the interval including Carrington rotations 1601-1680, May 5, 1973-April 26, 1979.** Harvey, J.; Gillespie, B.; Miedaner, P.; Slaughter, C. (World Data Center A for Solar-Terrestrial Physics, Boulder, CO (USA)). Aug 1980. 75p. NTIS, PC A04/MF A01.

A program of regular observations of solar magnetic fields was started at Kitt Peak National Observatory in April 1973, primarily in response to the needs of the Skylab mission. At first, the observations were made with the 40-channel magnetograph at the McMath telescope. During 1973 a telescope dedicated to synoptic studies was completed, and starting in 1974, observations were made with a 512-channel magnetograph. Daily full disk observations were first combined into synoptic maps during the Skylab Solar Workshop on Coronal Holes and High Speed Wind Streams and were used for studies of the magnetic field strength below coronal holes and extrapolations of the magnetic field into the corona, but these maps have never been published. Starting with Carrington rotation number 1681 the synoptic maps have been produced and published regularly in Solar-Geophysical Data, Part I (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colorado). Old data obtained prior to Carrington rotation number 1681 have now been processed into synoptic maps in the same way as current data are processed, and this publication presents these earlier maps in the same format.

31327 **(PB—81-852600) Gravitational effects on particle motions. January 1972-September 1980 (citations from the International Aerospace Abstracts data base). Report for January 1972-September 1980.** Frey, J.H. (New England Research Application Center, Storrs, CT (USA)). Oct 1980. 164p. NTIS PC N01/MF N01.

This retrospective bibliography contains citations concerning theoretical and analytical studies of the effects of gravity upon the motions of microscopic and macroscopic, charged and neutral, and relativistic and non-relativistic particles wherever they exist in the universe. Much of the emphasis is in cosmological, astrophysical, and planetological applications. Particles considered range from asteroids to rain drops to ions to relativistic tachyons. (Contains 220 citations.)

31328 **X-ray heating and ionization of broad-line emission regions in QSOs and active galaxies.** Weisheit, J.C.; Shields, G.A.; Tarter, C.B. (Plasma Physics Laboratory, Princeton University). *Astrophysical Journal ;* **245**: No. 2, 406-415(15 Apr 1981).

Absorption of X-rays deep within the broad-line emitting clouds in QSOs and the nuclei of active galaxies creates extensive zones of warm ($T \sim 10^4$ K), partially ionized (N/sub e//$N \sim 0.1$) gas. Because Lα photons are trapped in these regions, the X-ray energy is efficiently channeled into Balmer lines collisionally excited from the n = 2 level. These H I regions plus the H II regions created by ultraviolet photons illuminating the surfaces of the clouds give rise to integrated Lα/Hα line emission ratios between 1 and 2. Enhanced Mg II line emission from the H I regions gives rise to integrated Mg II/Hα ratios near 0.5. The O I line λ8446 is efficiently pumped ty trapped Hα photons, and, in the X-ray heated zone, we calculate an intensity ratio I(λ8446)/I(Hα)< or ≈0.1. All of these computed ratios are now in agreement with observations.

31329 **Galactic cosmic ray diffusion with arbitrary radial distributions.** Wallace, J.M. (Los Alamos Scientific Laboratory). *Astrophysical Journal ;* **245**: No. 2, 753-763(15 Apr 1981).

A diffusion model for galactic, high-energy, nuclear cosmic rays is presented which incorporates arbitrary source and interstellar gas radial distributions in the disk. An approximate analytical solution to the diffusion equation is presented and shown to be accurate in situations of current interest.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 31322

31330 (AD—363391) Effects of atomic explosions on the ionosphere. Daniels, F.B.; Harris, A.K.; Goldman, D.T. (Army Electronics Labs., Fort Monmouth, NJ (USA)). Aug 1954. 64p. NTIS, PC A04/MF A01.

During Operation Ivy an ionosphere recorder was operated at some distance from the test site. In addition, hf radio transmissions with paths nearly over the blast area were monitored. A new phenomenon was observed in connection with the larger shot. It consisted of a sustained rise in the virtual height of the F2 layer, lasting more than 3 hr, and a simultaneous depression from normal values of the F2 critical frequency. These effects, although only relatively local in extent, are likened to those normally observed over large portions of the earth during magnetic storms. A possible physical explanation is propounded, based upon the hypothesis that much of the vertically propagated infrasonic energy produced by an explosion of this size is converted into heat in the lower portion of the F2 region. Other effects on the ionosphere, observed during both shots, were similar to those recorded during earlier operations and corrobrated previous theory attributing them to local changes of ion density caused by the sonic wave acting on the ionized layers. No major disturbance to ionospheric communications was found. However, some attenuation of all radio waves passing through the D and E regions in the vicinity of the blast was observed, lasting only 15 min or thereabouts.

31331 (AD—809025) Delayed generation of an electromagnetic pulse in the ionosphere and in other magneto-plasmas. Muldrew, D.B. (Defence Research Telecommunications Establishment, Ottawa, Ontario (Canada)). Jan 1967. 35p. NTIS, PC A03/MF A01.

This report is concerned with the physical process responsible for the delayed generation of an electromagnetic pulse in the ionosphere. This effect, which is caused by electron resonance, often shows up in high latitude, topside spread F ionograms as a trace that protrudes from the spread F of the extraordinary wave trace. It occurs at frequencies slightly greater than twice the electron gyrofrequency at the height of the satellite (E. L. Hagg, 1966). The characteristics of this trace (remote resonance trace) can be explained by the following model: a transmitted pulse of angular frequency omega propagates downward, along a magnetic field-aligned wave guide, through the height at which omega is equal to twice the angular electron gyrofrequency 2 omega sub H. A gradient in the electric field of the transmitted wave results from the wave propagating along the guide. Due to this gradient, electrons gyrating about the magnetic field with certain phases (measured from a fixed direction in a plane normal to the magnetic field) can gain energy from the wave, whereas electrons with other phases can lose energy to the wave; the electrons can thus be considered to be 'energy bunched'.

31332 (AD-A—091169) Spectral characteristics of medium-scale equatorial f-region irregularities. Topical report 1 Jan-29 Feb 1980. Livingston, R.C.; Rino, C.L. (SRI International, Menlo Park, CA (USA)). 1 Mar 1980. Contract DNA001-80-C-0077. 37p. NTIS, PC A03/MF A01.

The spectral characteristics of equatorial F-region irregularities with scale sizes from a few kilometers to several hundred kilometers have been measured using data from the Atmospheric Explorer-E (AE-E) satellite. The spectra admit the expected power-law characterization with a mean spectral index slightly less than 2. The spectral index, p1, however, decreases with increasing perturbation strength. The same data have been compared with nearly simultaneous phase scintillation data from the Wideband satellite. The power-law index of the phase scintillation data varies with perturbation strength in exactly the same manner as does p1. With realistic propagation model parameters, the scintillations-inferred perturbation levels can be made to match those measured in-situ. However, the long-accepted unity separation between the in-situ and phase spectral indices is not observed. This discrepancy is attributed either to shortcomings in the theory or to lack of temporal/spatial comparability of the two measurements.

31333 (AD-A—091744) Infrared emission spectroscopy of low pressure gaseous discharges. III. Interim report. Sakai, H. (Massachusetts Univ., Amherst (USA). Astronomy Research Facility). May 1980. Contract F19628-76-C-0087. 33p. NTIS, PC A03/MF A01.

Our study conducted on the infrared NH band is described in this report. The emission was observed both in decomposition and in recombination processes.

31334 (AD-A—091816) Space environmental studies: instrumentation and data analysis related to the ionosphere. Final report 15 may 77-31 may 80. Rich, F.; Anderson, P.B. (Regis Coll., Weston, MA (USA)). 2 Sep 1980. Contract F19628-77-C-0122. 69p. NTIS, PC A04/MF A01.

The objective of this contract has been to design instrumentation for the Plasma, Particles and Field Branch, Space Physics Division of the Air Force Geophysics Laboratory and to analyze data from these instruments and related instruments flown on the same vehicles. In particular, the design and check out of the thermal plasma instruments for SCATHA (SC5) and for DMSP Flights 2, 4 and 5 of the Block 5D series has been done. Design work for DMSP Flights 6 through 10 has also been done. The data analysis has been done to understand and improve the quality of future instruments. For example, the electronics for the thermal plasma experiments on Flights 4 through 7 was done after an unexpected vehicle electrostatic potential problem was identified from the Flight 2 in-flight data records. The data analysis was also done to improve the general knowledge of the ionosphere.

31335 (PB—81-125551) Auroral electrojet magnetic activity indices AE(12) for July-December 1975. Allen, J.H.; Abston, C.C.; Salazar, J.E.; McKinnon, J.A. (World Data Center A for Solar-Terrestrial Physics, Boulder, CO (USA)). Aug 1980. 123p. NTIS, PC A06/MF A01.

The Auroral Electrojet index (AE) is discussed and a brief description is given of the derivation of 12-station 1.0-min AE indices for July-December 1975. Tables are given of hourly average indices for each day, of the stations making the main contribution to the hourly indices, and of the average monthly quiet-time level of horizontal fields (H) at each magnetic observatory. Graphs of the index variations are included for each day of the second half of 1975 and for the frequency and amplitude of extreme variations at each site.

31336 (PB—81-852519) Gravitational considerations for atmospheric circulation and composition. January 1972-September 1980 (citations from the International Aerospace Abstracts data base). Report for January 1972-September 1980. Frey, J.H. (New England Research Application Center, Storrs, CT (USA)). Oct 1980. 80p. NTIS PC N01/MF N01.

This retrospective bibliography contains citations concerning the detection, observation, and measurement of gravitational effects upon both planetary and stellar atmospheric circulations and compositions. Included are studies concerning theoretical considerations and atmospheric drag effects relating to the atmospheric circulations and compositions. (Contains 110 citations.)

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 30537

31337 (AD-A—090856) Application of laser spectroscopy to collisional studies. Berman, P.R. (New York Univ., NY (USA). Dept. of Physics). 1979. Contract N00014-77-C-0553. 10p. NTIS, PC A02/MF A01.

The traditional method for studying atomic or molecular collisions is the use of crossed atomic or molecular beams. Owing to the low beam densities one encounters, such studies have generally been restricted to atoms or molecules in ground or metastable states; however, it is now possible to use lasers to achieve substantial excited state atomic populations so that scattering from excited states may also be studied in crossed beam experiments. Typically, one obtains the differential scattering cross section as a function of center-of-mass energy in crossed beam experiments. These experiments, although often difficult to perform, provide a 'direct' measure of the scattering process.

31338 **(AD-A—090951) The drift, diffusion, and reactions of slow ions in gases. Final report 1 Jul 1975-28 Feb 1980.** McDaniel, E.W.; Gatland, I.R. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). 28 Feb 1980. Contract N00014-76-C-0015. 7p. NTIS, PC A02/MF A01.

The Georgia Tech program of research on ionic transport in gases is described. Experimental measurements of ionic mobilities and diffusion coefficients are discussed. The use of mobility data to obtain ion-neutral interaction potentials is described. References are given for publications covering this report period.

31339 **(AD-A—091248) Collision-induced transfer rates connecting fine-structure levels in diatomic sulfur in an excited vibrational level where v'=4. Technical report.** Caughey, T.A.; Crosley, D.R. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Aug 1980. 34p. NTIS, PC A03/MF A01.

Rates for collision-induced transfer between a single rotational level (v = 4, J = 41) and other individual rotational levels within the same vibrational level of the B-state of diatomic sulfur are reported. The sulfur was excited into the B-state by the radiation from an atomic zinc lamp, and rotationally resolved fluorescence measurements were used to determine the rates for the collision partners He, Ar and Xe.

31340 **(AD-A—091506) The broadening of spectral lines by autoionization, radiative transitions, and collisions. Memorandum report.** Jacobs, V.L.; Davis, J. (Naval Research Lab., Washington, DC (USA)). 22 Oct 1980. 47p. NTIS, PC A03/MF A01.

A comprehensive quantum mechanical theory of atomic spectral line shapes is developed within the framework of the Lippmann - Schwinger scattering theory adapted to the tetradic (Liouville) - space representation of density matrices. An expression for the spontaneous electric-dipole rate is derived which has the same general form as the results obtained by Baranger and by Kolb and Griem for overlapping lines. The frequency-dependent relaxation operator which occurs in this expression involves not only the collisional broadening interaction but also the interactions which give rise to autoionization and to both spontaneous and induced radiative transitions. Explicit expressions for the widths are obtained in the isolated-line approximation by evaluating the lowest-order nonvanishing contribution to the diagonal matrix elements of the relaxation operator. The total width is obtained as the sum of the rates for all inelastic transitions from the initial and final states comprising the spectral line and the term involving the square of the difference between the elastic scattering amplitudes. Finally, we present a qualitative discussion on how the partial widths vary with the states comprising the spectral line and with the physical properties of the surrounding particles and radiation field.

31341 **(AD-A—091611) Molecular beam studies of low energy reactions. Annual summary report.** Neynaber, R.H. (IRT Corp., San Diego, CA (USA)). 31 Oct 1980. Contract N00014-80-C-0149. 9p. NTIS, PC A02/MF A01.

The report describes merging-beams studies of chemi-ionization and ion-molecule reactions. Included are investigations of the Ne*-Ar*, He*-Ne*, and HCl+-Xe systems. A description is also given of how this research helps resolve unknown aspects of the areas investigated.

31342 **(BNL—29896) Mechanistic studies of electron exchange kinetics using ab initio.** Newton, M.D. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 25p. (CONF-8106139—2). NTIS, PC A02/MF A01. Order Number DE81026096.

From Symposium on inorganic reaction mechanisms; Detroit, MI, USA (10 Jun 1981).

The rate constant for the aqueous Fe^{2+}-Fe^{3+} electron exchange reaction is calculated as k/sub ex/= $\int 4\pi r^2 g(r)$k/sub el/(r)dr, where k/sub el/ is the first-order rate constant for outer-sphere exchange when the Fe complexes are separated by r and g(r) is the pair distribution function for the reacting inner sphere complexes. A simple primitive model is employed for g(r) and the effective contact distance (r/sub min/) is taken as 5.5 A, the value at which the staggered face-to-face configuration of the orthohedral complexes achieves van der waals contact (via the water hydrogen atoms). The electronic coupling information implicit in k/sub el/(r) is obtained from large scale ab initio molecular orbital calculations carried out for the diabatic states of the reactive ion pair. The calculated rate constant, k/sub ex/, and associated activation parameters are in good agreement with experimental data extrapolated to zero ionic strength and correspond to a mechanism dominated by direct Fe-Fe overlap and characterized by a modest degree of nuclear tunnelling and non-adiabatic character.

31343 **(CONF-810734—2) Studies of photoionization in liquids using a laser two-photon ionization conductivity technique.** Siomos, K.; Christophorou, L.G. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE81026514.

From 7. international conference on conduction and breakdown in dielectric liquids; Berlin, F.R. Germany (27 Jul 1981).

One-photon ionization studies of solute molecules in a liquid medium are limited by the absorption of the host medium. A laser two-photon ionization (TPI) technique using a frequency tunable dye laser has been developed, whereby the photoionization threshold of a solute molecule was determined from the induced conductivity in the liquid medium under study due to electron-ion pair formation via two-photon ionization of the solute. The two-photon induced electron-ion current is measured as a function of the laser wavelength, λ/sub laser/. In this paper, results are reported and discussed on the photoionization of N,N,N',N'-tetramethyl-p-phenylenediamine (TMPD), pyrene and fluoranthene in liquid n-pentane (n-Pt).

31344 **Truncated expansion of the ground-state energy of a neutral atom in powers of Z/sup (-1/3)/; coefficients of the leading terms.** Shakeshaft, R.; Spruch, L. (New York Univ., NY (USA). Dept. of Physics); Mann, J.B. (Los Alamos Scientific Lab., NM (USA)). *Journal of Physics B: Atomic and Molecular Physics ;* **14**: No. 4, L121-L125(28 Feb 1981).

Numerical estimates of the ground-state energy E of a neutral atom of atomic number Z have been obtained for a few values of Z ranging from 86 to 290 by performing atomic self-consistent-field calculations, treating exchange exactly, using a statistical approximation for correlation, and neglecting relativistic corrections. These numerical values are used to estimate the coefficients in a truncated expansion of E powers of Zsup(-1/3).

31345 **(DOE/ER/40001—1) University of Wisconsin, Department of Physics. Technical progress report, February 1, 1981-May 30, 1981.** (Wisconsin Univ., Madison (USA). Dept. of Physics). Jul 1981. Contract AC02-81ER40001. 27p. NTIS, PC A03/MF A01. Order Number DE81026306.

Progress on the development of optically pumped polarized ion sources is reported. The production of polarized Li^- or Na^- ions is based on the production of Li or Na atoms by an atomic oven, polarization of the Li or Na atoms by optical pumping, ionization on a heated oxidized tungsten surface to form Li^+ or Na^+ ions, and converted to polarized Li^- or Na^- ions in a potassium or cesium vapor cell. The conversion of $^3He^+$ ions into polarized $^3He^-$ ions will be accomplished by the pickup in a low magnetic field of two electrons in two separate collisions in an optically pumped electron spin polarized Na vapor target. Polarized H^- ions are produced by using an optically pumped electron spin polarized Na vapor target in a large magnetic field to partially convert H^+ ions into electron spin polarized H^0 atoms. The electron spin polarization is transferred to the proton by a Sona diabatic transition. The fast nuclear polarized H^0 atoms are then partially converted to polarized H^- ions in a second unpolarized alkali vapor target. (WHK)

31346 **(DOE/ET/53048—T1) Collision cross sections and equilibrium fractions of ions and atoms in metal-vapor targets. Project progress report, June 1, 1980-April 30, 1981.** Morgan, T.J. (Wesleyan Univ., Middletown, CT (USA)). 1981. Contract AC02-76ET53048. 4p. NTIS, PC A02/MF A01. Order Number DE81027886.

The objective of this program is to measure atomic collision cross sections and equilibrium fractions of ions and atoms in metal

vapor targets. The goal is to obtain experimental information on atomic collision processes of importance to the Magnetic Fusion Energy Program. In particular, in connection with the development of negative ion sources, we have measured D^- formation cross sections in alkaline-earth metal vapor targets. During the period covered in this report we have completed electron transfer cross section measurements of D^+ ions and D^0 atoms in collision with calcium and strontium vapor. We have also completed differential cross section measurements for H^- formation in H^+ + Mg collisions. Finally, state-of-the-art computer instrumentation has been interfaced to the experiment.

31347 **(DOE/OR/05784—1) Selective excitation, relaxation, and energy channeling in molecular systems. Progress report, December 1, 1980-November 30, 1981.** Rhodes, W.C. (Florida State Univ., Tallahassee (USA)). 1981. Contract AS05-78OR05784. 14p. NTIS, PC A02/MF A01. Order Number DE81028658.

This research deals with the selective excitation, relaxation, and energy-channeling processes in molecular systems. The most significant results during the past year are as follows: (1) the role of the intensity of laser coupling with a molecule on the dynamics and selectivity of nonradiative processes has been studied theoretically and quantitatively in terms of computer simulations for some simple multistate models. This complements existing results which emphasize frequency selectivity of photochemical and photophysical processes; (2) the stochastic effects of the molecular medium (bath) have been formulated in terms of molecular energy surfaces for the molecule-bath modes and the associated sudden potential. This leads to a better understanding of the microscopic quantum bases for stochastic modulation effects on resonance emission of light; and (3) two distinct kinds of molecular resonances (termed dissipative and stochastic) have been formulated in terms of prototype coupling schemes for a molecule and the modes to which it is coupled. The resulting theory has led to new perspectives of the role of background interactions of a molecule with its medium on the kinetics and dynamics of molecular processes. Specifically, (a) a coupling strength ordering rule has been developed which explains the propensity for kinetic slowing effects due to background interactions; and (b) the tendency for stochastic modulation to induce sequential and parallel resonances has been discovered.

31348 **(DOE/SF/00936—T1) Energy-deposition studies. Final report.** Vroom, D.A. (IRT Corp., San Diego, CA (USA)). 31 Aug 1976. Contract AM03-76SF00936. 45p. NTIS, PC A03/MF A01.

Studies on energy deposition in materials by high energy radiation based on excitation measurements and measurements of secondary electron emission from the ionization process are reported. The experimental apparatus used for studying excitation in low-energy electron collisions with hydrogen and deuterium is described. Differential angular distribution measurements of photoelectrons emitted from water vapor and nitric oxide are reported. Also, electron impact secondary electron differential cross sections are presented for hydrogen, methane, acetylene, ethylene, ethane, propane, and butane at 1, 2.5, 5, 7.5, and 10 keV. (WHK)

31349 **(LBL—12981) Infrared vibrational predissociation spectroscopy of small molecular clusters.** Lisy, J.M.; Vernon, M.F.; Tramer, A.; Kwok, H.S.; Krajnovich, D.J.; Shen, Y.R.; Lee, Y.T. (Lawrence Berkeley Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 9p. (CONF-8106100—4). NTIS, PC A02/MF A01. Order Number DE81028648.

From International conference on laser spectroscopy; Alberta, Canada (29 Jun 1981).

The structure and interaction of small molecular clusters have been the subject of extensive studies. Molecular beam electric resonance spectroscopy, Fourier-transform microwave spectroscopy and pressure induced infrared absorption spectra have provided information concerning the ground state structure and the intermolecular potential energy surface for a large number of binary systems. Recently, vibrational predissociation experiments using molecular beam techniques and tunable infrared lasers have measured the infrared absorption spectra and dynamical properties of many van der Waals and hydrogen bonded clusters.

31350 **(PB—81-125833) Bibliography on atomic energy levels and spectra. Interim report, July 1975-June 1979.** Zalubas, R.; Albright, A. (National Bureau of Standards, Washington, DC (USA)). Oct 1980. 124p. NTIS, PC A06/MF A01.

This is the second supplement to NBS Special Publication 363, Bibliography on Atomic Energy Levels and Spectra, July 1968 through June 1971. Supplement 1 covered the period from July 1971 through June 1975, and this bibliography covers the literature from July 1975 through June 1979. It contains approximately 1200 references classified by subject for individual atoms and atomic ions. A number index identifies the references. An author index is included. References included contain data on energy levels, classified lines, wavelengths, Zeeman effect, Stark effect, hyperfine structure, isotope shift, ionization potentials, or theory which gives results for specific atoms or atomic ions.

31351 **(RFP—3228) Dynamic mass spectrometry: a residual gas analysis method and some applications.** McFeeters, T.L. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1981. Contract AC04-76DP03533. 18p. (CONF-8106101—1). NTIS, PC A02/MF A01. Order Number DE81026230.

From Symposium on energy and environment, turbomachinery technology; Patras, Greece (22 Jun 1981).

Dynamic mass spectrometry is a unique method of residual gas analysis used to monitor and trouble-shoot industrial vacuum process operations. This discussion presents applications and results of the method, and describes the equipment and analytical method developed at Rocky Flats to perform this work. GHT)

31352 **(UCRL—85304) Recent developments in complex scaling.** Rescigno, T.N. (Lawrence Livermore National Lab., CA (USA)). 15 Dec 1980. Contract W-7405-ENG-48. 23p. (CONF-8005162—2). NTIS, PC A02/MF A01. Order Number DE81026564.

From Workshop on electron-atom and electron-molecule collisions; Bielefeld, F.R. Germany (5 May 1980).

Some recent developments in the use of complex basis function techniques to study resonance as well as certain types of nonresonant, scattering phenomena are discussed. Complex scaling techniques and other closely related methods have continued to attract the attention of computational physicists and chemists and have now reached a point of development where meaningful calculations on many-electron atoms and molecules are beginning to appear feasible.

31353 **Auger spectra of methyl cyanide and related compounds.** Rye, R.R.; Houston, J.E. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics ;* **75**: No. 5, 2085-2090(1 Sep 1981).

The gas phase, electron excited Auger spectra of CH_3CN, C_2H_2, N_2, and CH_4 are presented and analyzed. The C(KVV) spectrum of CH_3CN, which contains two carbon atoms with different local environments, is shown to be consistent with independent contributions from an acetylenic-like, sp hybridized carbon (the cyanide carbon) and from a methyl-like, sp^3 hybridized carbon (the terminal methyl carbon). The cyanide N(KVV) spectrum is shown to be similar in shape to that of N_2 but shifted in energy. Analysis of the CH_3CN spectrum on a two-hole binding energy scale shows that the Auger process leads to the same set of doubly ionized final states starting from different core—hole sites in the molecule, but with intensities modulated by the polarization of individual molecular orbitals, i.e., the variation of the electron density local to the various atomic sites represented by a particular molecular orbital. In addition, it is shown that the interaction of the two final-state holes resulting from the Auger transition gives rise to shifts of the spectrum towards lower kinetic energies with respect to that predicted for noninteracting holes, and that these shifts vary in magnitude across the Auger feature.

31354 **Effect of vibration and translational energy on the reaction dynamics of the $H^+Z + H_2$ system.** Anderson, S.L.; Houle, F.A.; Gerlich, D.; Lee, Y.T. (Materials and Molecular Research Division of the Lawrence Berkeley Laboratory). *Journal of Chemical Physics ;* **75**: No. 5, 2153-2162(1 Sep 1981).

A new experimental technique combining molecular beams, photoionization, and guided beam ion optics has been used to study several isotopic $H_2^+ + H_2$ reactions. The technique is described. By using this method we are able to observe the effects of both reagent translational and vibrational energy. Cross sections are reported for charge transfer, H_3^+ formation, and collision induced dissociation. Evidence is seen for competition betwen the channels, charge hopping in the reaction entrance channel, potential energy surface hopping, reaction on excited potential surfaces, and isotopic scrambling. A model for the reaction which takes into account the multisurface nature of the systems seems to explain the results satisfactorily.

31355 **Floquet theory and complex quasivibrational energy formalism for intense field molecular photodissociation.** Chu, S. (Department of Chemistry, University of Kanas, Lawrence, Kansas 66045). *Journal of Chemical Physics ;* **75**: No. 5, 2215-2221(1 Sep 1981).

A practical and nonperturbative method is presented for studying molecular photodissociation processes in the presence of (weak or intense) electromagnetic fields, using only square-integrable (L^2) functions. By means of the complex coordinate transformation and L^2 discretization of the vibrational continua, the complex quasivibrational energies (QVE) of the Floquet Hamiltonian can be determined by standard non-Hermitian eigenvalue analysis. The real parts of the QVE's provide the ac Stark-shifted vibronic energies, whereas the imaginary parts are related to the photodissociation transition rates. The theory is applied to the direct photodissociation of $H^+_2(1s\sigma/sub\ g/—2p\sigma/sub\ u/)$ in both weak and strong fields.

31356 **Unified semiclassical perturbation and infinite order sudden approximation, with application to the reaction path Hamiltonian model.** Miller, W.H.; Shi, S. (Department of Chemistry and Materials and Molecular Research Division of the Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics ;* **75**: No. 5, 2258-2264(1 Sep 1981).

It is shown how two popular approximate dynamical models: the semiclassical perturbation (SCP) approximation and the infinite order sudden (IOS) approximation: can be combined in a consistent way that includes the correct features of both. Application of this unified SCP—IOS approximation to the reaction path Hamiltonian model of Miller, Handy, and Adam [J. Chem. Phys. 72, 99 (1980)] leads to extremely simple, explicit formulas for the reactive S matrix, product state distrubutions, etc., which can be readily applied to polyatomic systems. Initial numerical tests on a simple model problem indicate that the model is of useful accuracy.

31357 **Complete wave equation of a nonlinear polyatomic molecule.** Webster, F.; Huang, M.; Wolfsberg, M. (Department of Chemistry, University of California, Irvine, California 92717). *Journal of Chemical Physics ;* **75**: No. 5, 2306-2313(1 Sep 1981).

The complete nonrelativistic wave equation of a nonlinear polyatomic molecule, including the electronic motion, is formulated in molecule fixed coordinates. The method is an extension of that used by Pickett to obtain the molecular rotation—vibration wave equation. Both the choice of rotating axes and the choice of internal vibrational coordinates are general. The transformation to quantum mechanics is undertaken after the rotating axes and the vibrational coordinates have been introduced. The total molecular wave function, after elimination of the motion of the center of mass, is written as a sum of products of eignfunctions of the rigid symmetric top Hamiltonian and of functions of the internal molecular (vibrational and electronic) coordinates. The coupled wave equations for the functions of internal coordinates are derived. Application is made to a nonlinear triatomic molecule and the result is compared with a previous formulation. By contrast to the present formulation, the transformation to quantum mechanics in the previous formulation had been carried out for the Hamiltonian in space fixed coordinates.

31358 **Comparison of silver atom solvation in glassy and polycrystalline ices.** Ichikawa, T.; Li, A.S.W.; Kevan, L. (Faculty of Engineering, Hokkaido University, Sapporo 060, Japan). *Journal of Chemical Physics ;* **75**: No. 5, 2472-2473(1 Sep 1981).

Electron spin echo studies have been carried out for Ag^0 in a 9 M sodium perchlorate aqueous glassy matrix at 4.2 K. The analysis of the nuclear modulation patterns shows that the hydration structure of Ag^0 initially formed at 4.2 K is the same as that in polycrystalline ice. In contrast to polycrystalline ice, no change in the solvation structure takes place upon warming the sample to 77 K. The solvation process via OH bond rotation in polycrystalline ice is suggested to occur via defects in the ice structure adjacent to Ag^0 in addition to hydrogen bonding interactions. (AIP)

31359 **Coincidence measurements of electron capture and ionization in low-energy Ar/sup +q/+(He, Ne, Ar, Xe) collisions.** Cocke, C.L.; DuBois, R.; Gray, T.J.; Justiniano, E.; Can, C. (J.R. Macdonald Laboratory, Kansas State University, Manhattan, Kansas 66506). *Physical Review Letters ;* **46**: No. 26, 1671-1674(29 Jun 1981).

We have used a secondary-ion recoil source to study charge transfer and ionization in collisions of Ar/sup +q/ with He, Ne, Ar, and Xe at projectile energies between 250 and 660 eV per charge. By analyzing outgoing projectiles and target ions in coincidence we have measured cross sections for ionization with and without simultaneous capture, as well as for normal charge exchange. Cross sections for direct ionization without capture are found to be small, whereas those for transfer ionization are often quite important.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 31062

31360 **(LA-UR—81-1421) Lagrangian fluid dynamics using the Voronoi-Delauanay mesh.** Dukowicz, J.K. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 30p. (CONF-810916—1). NTIS, PC A03/MF A01.

From International conference on numerical methods for coupled problems; Swansea, UK (Sep 1981).

A Lagrangian technique for numerical fluid dynamics is described. This technique makes use of the Voronoi mesh to efficiently locate new neighbors, and it uses the dual (Delaunay) triangulation to define computational cells. This removes all topological restrictions and facilitates the solution of problems containing interfaces and multiple materials. To improve computational accuracy a mesh smoothing procedure is employed.

31361 **Modern potentials and the properties of condensed ^{4}He.** Kalos, M.H.; Lee, M.A.; Whitlock, P.A.; Chester, G.V. (Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, New York 10012). DE-AC02-76ER03077. *Physical Review* [*Section*] *B: Condensed Matter ;* **24**: No. 1, 115-130(1 Jul 1981).

The Green's-function Monte Carlo method has been used to calculate the properties of the ground-state ^{4}He with several modern potentials. One potential, dubbed HFDHE2, by Aziz et al., gave very good agreement with the experimental equation of state in both the liquid and crystal phases. Other properties such as the structure factor and the momentum distribution also compare well with the experiment. In both phases, perturbative estimates of the three-body Axilrod-Teller potential were computed. When they are added to the two-body energies, the total energy is no longer in agreement with experiment. Further investigation on the nature of three-body interactions in the ^{4}Fe may be necessary to elucidate this problem.

31362 **Constraints imposed upon theories of the vacuum arc cathode region by specific ion energy measurements.** Miller, H.C. (General Electric Company, Neutron Devices Department, P. O. Box 11508, St. Petersburg, Florida 33733). DE-AC04-76DP00656. *Journal of Applied Physics ;* **52**: No. 7, 4523-4530(Jul 1981).

The presence of high-energy ions (with potentials greater than the overall arc voltage) in the flux from the cathode region of vacuum arcs has been well established. While much excellent theoretical work has been done on the cathode region of a vacuum arc, only a modest amount of such work has predicted the energies of the ions leaving the cathode region. Two vacuum arc cathode theories which do predict the ion energies are the potential hump theory: where a positive space charge at the cathode spot accelerates the ions electrostatically, and the gas dynamic theory: where the ions are accelerated by a flow process. Few theorists have taken advantage of the available mass spectrometric data concerning individual ion energies. In this paper I compare such data with theoretical predictions. The best confirmed ion energy data is that for a copper cathode. Additional data are presented concerning the ion flux from a vacuum arc with a ten percent Bi/Cu cathode. Comparison of the copper and bismuth/copper data with the theoretical predictions shows that the potential hump and gas dynamic theories are in rough agreement with experiment, but are definitely not correct. Modifying the potential hump and gas dynamic theories by considering time-dependent phenomena (i.e., incorporating nonequilibrium states into the theory) is shown to offer the promise of bringing either theory into better agreement with experiment. I conclude that the available data on the energies of the ions leaving the cathode region of a vacuum arc can serve as strong constraints on theoretical analyses.

31363 **Fluid damping for circular cylindrical structures.** Chen, S.S. (Argonne National Lab., IL (USA). Components Technology Div.). *Nuclear Engineering and Design ;* **63**: No. 1, 81-100(Jan 1981).

Fluid damping plays an important role for structures submerged in fluid, subjected to flow, or conveying fluid. This paper presents a summary of fluid damping for circular cylinders vibrating in stationary fluid, cross flow, and parallel flow.

31364 **Fluid damping distortion in FIV scale modeling.** Mulcahy, T.M. (Argonne National Lab., IL (USA). Components Technology Div.). *Nuclear Engineering and Design ;* **63**: No. 1, 101-107(Jan 1981).

The prediction of flow-induced vibrations (FIV) of structural components often must rely upon scale model test results, because direct forced response predictions are beyond the state-of-the-art. Since viscosity effects often are distorted in reduced scale model tests, the identification of fluid forces which are Reynolds number dependent is essential to the acquisition of meaningful test results. Toward this end, the fluid damping forces exerted on a vibrating tube by a surrounding narrow, fluid filled, finite length annular region are shown to be relatively larger in the model than in the prototype. A theory is proposed for estimating the magnitude of this unconservative distortion in model testing.

6451 Particle Interactions And Properties - Experimental

31365 **(DOE/ER/02232—4) Final technical progress report, May, 1978-April 30, 1981.** (Rockefeller Univ., New York (USA)). 1981. Contract AC02-76ER02232. 84p. NTIS, PC A05/MF A01. Order Number DE81027887.

Four technical progress reports, each covering one year, are incorporated as a four year summary of high energy physics research done by Rockefeller University from 1978 to 1981. (GHT)

31366 **(DOE/ER/03065—T2) Progress report for 1980 to 1981.** (Duke Univ., Durham, NC (USA). Dept. of Physics; State Univ. of New York, Albany (USA). Dept. of Physics). 1981. Contract AS05-76ER03065. 141p. NTIS, PC A07/MF A01. Order Number DE81028659.

Portions of document are illegible.

Completed research in direct e^+e^- pair production from hadronic bremsstrahlung, and π^0 production from πp and πNe collisions at 200 GeV; as well as ongoing research in π^+ p interactions at 15.7 GeV/c, and γp interactions at 19.5 GeV/c is reviewed. (GHT)

31367 **(DOE/ER/03130—T4) Progress report of a research program in experimental high energy physics, January 1, 1981-December 31, 1981.** Shapiro, A.M.; Widgoff, M. (Brown Univ., Providence, RI (USA)). 1 Jul 1981. Contract AC02-76ER03130. 45p. NTIS, PC A03/MF A01. Order Number DE81025723.

An experimental program to study the interactions of hadrons and photons is being carried out using hybrid systems which include bubble chambers as visible targets as well as counter spectrometers for particle detection, measurement and identification. Experiments are now being carried out at Fermilab and SLAC, and additional experiments have been approved for the Tevatron at Fermilab and for the SPS at CERN. During the spring of 1981, the first of long-awaited data were obtained for the study of π^{+-}, K^+ and p^{+-} interactions in hydrogen and in magnesium, silver and gold, at a beam momentum of 200 GeV/c (FNAL E-565/570). The first fruit of this exposure is an analysis of the multiplicity distribution as a function of atomic number A, which these experiments will yield with much greater precision than has been available by any other technique. A similar experiment at 250 GeV/c is planned using the European Hybrid Spectrometer, and is now scheduled to start data-taking in the summer of 1982. During the past year successful runs were also made with the Stanford Hybrid Facility in polarized monoenergetic photon beams of 13 GeV/c and 20 GeV/c, continuing the work begun earlier in 1980 (SLAC BC-72/73). Preliminary results have already been obtained on photoproduction of charm and of vector mesons. Extensive work continues on the analysis of our earlier FNAL experiment on π^+p, K^+p and pp interactions at 147 GeV/c (FNAL E-299).

31368 **(DOE/ER/03992—452) Research program in elementary-particle theory, 1981. Progress report.** Sudarshan, E.C.G.; Ne'eman, Y. (Texas Univ., Austin (USA). Center for Particle Theory). 1981. Contract AS05-76ER03992. 78p. NTIS, PC A05/MF A01. Order Number DE81028454.

Progress is reported for research in the physics of ultra high energies and cosmology, the phenomenology of particle physics, composite models of particles and quantum field theory, quantum mechanics, geometric formulations, fiber bundles, and other algebraic models. (GHT)

31369 **(DOE/ER/04043—T1) Experiments on the nuclear interactions of pions. Progress report, December 1, 1980-November 30, 1981.** Minehart, R.C.; Ziock, K.O.H. (Virginia Univ., Charlottesville (USA). Dept. of Physics). 1981. Contract AS05-76ER04043. 71p. (ORO—4043-41). NTIS, PC A04/MF A01. Order Number DE81028657.

Progress is reviewed in these research areas: π-d elastic scattering; π-elastic and quasi-free scattering from helium isotopes; pion charge exchange in ^{3}He; pion absorption in ^{3}He and ^{4}He; quasi-free pion scattering; $\pi \rightarrow \mu + \nu$ experiment; study of the $\pi^0 \rightarrow 2e$ decay; measurement of the $\pi^- - \pi^0$ mass difference; design of a low energy pion spectrometer; $\pi + d \rightarrow p + p$ in the energy range 60 to 200 MeV. (GHT)

31370 **(DOE/ER/04449—34) Study of the neutron-proton interaction in the 300-700 MeV energy region. Annual progress report, 1980-1981.** Northcliffe, L.C. (Texas A and M Univ., College Station (USA). Research Foundation). 1981. Contract AS05-76ER04449. 41p. NTIS, PC A03/MF A01. Order Number DE81026733.

Research investigating nucleon-nucleon interactions in both elastic and inelastic channels at LAMPF energies was performed in cooperation with Los Alamos National Laboratory personnel. A summary is given of the experimental apparatus and method, and results obtained for neutron-proton interactions. (GHT)

31371 **(LA—8919-T) Measurement of the free neutron-proton analyzing power and spin transfer parameters in the charge exchange region at 790 MeV.** Ransome, R.D. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 240p. NTIS, PC A11/MF A01. Order Number DE81028664.

Thesis.

The free neutron-proton analyzing power and the spin transfer parameters (K/sub NN/, K/sub SS/, K/sub SL/, and K/sub

LL/) were measured at the Los Alamos Meson Physics Facility at 790 MeV between 165° and 180° center of mass. A 40% polarized neutron beam incident on a liquid hydrogen target was used. The recoil protons were momentum analyzed with a magnetic spectrometer to isolate elastic scatters. A large solid angle carbon polarimeter was used to measure the proton polarization. The measurements are the first at this energy and are in basic agreement with pre-existing phase shift solutions. The proton-carbon analyzing power was measured between 500 and 750 MeV. An empirical fit to the proton-carbon analyzing power between 100 and 750 MeV was done.

31372 **(SLAC-PUB—2745) Exclusive final states from photon-photon collisions at SPEAR.** Burke, D.L. (Stanford Linear Accelerator Center, CA (USA)). May 1981. Contract AC03-76SF00515. 22p. NTIS, PC A02/MF A01. Order Number DE81028782.

Studies of exclusive final states produced by the two-photon process have been made at SPEAR by the Mark II and by the Crystal Ball Collaborations. Measurements of $\pi^+\pi^-$ and $\pi^0\pi^0$ production in the mass region 500 MeV/c^2 < m/sub $\pi\pi$/ < 2000 MeV/c^2 are presented. These data include strong signals from the well-known f(1270) meson. The A_3(1310) has been observed via its π^0 eta decay mode and its partial width to $\gamma\gamma$ has been determined. A measurement of the cross section for the reaction $\gamma\gamma \rightarrow \pi^+\pi^-\pi^+\pi^-$ is reported. This channel is found to be small just above the four pion threshold, but exhibits a large enhancement near the rho^{0}rho^0 threshold.

31373 **(SLAC-PUB—2747) Two-photon physics as a probe of hadron dynamics.** Brodsky, S.J. (Stanford Linear Accelerator Center, CA (USA)). May 1981. Contract AC03-76SF00515. 21p. (CONF-810496—2). NTIS, PC A02/MF A01. Order Number DE81028757.

From 4. international colloquium on photon-photon interactions; Paris, France (6 Apr 1981).

Two-photon collisions provide an ideal laboratory for testing many features of quantum chromodynamics, especially the interplay between the vector-meson-dominated and point-like hadronic interactions of the photon. A number of QCD applications are discussed, including: jet and single-particle production at large transverse momentum; the photon structure function and its relationship to the $\gamma \rightarrow$ q anti q wave function; and the possible role of gluonium states in the $\gamma\gamma \rightarrow$ rho^{0}rho^0 channel. Evidence that even low momentum transfer photon-hadron interactions are sensitive to the point-like $\gamma \rightarrow$ q anti q coupling is discussed.

31374 **(UCI—34P149-1) Study of new heavy bosons in proton-antiproton interactions. Progress report, October 1, 1969-September 30, 1970.** Schultz, J.; Condon, P. (California Univ., Irvine (USA). Dept. of Physics). 1970. Contract AT03-76ER70149. 28p. NTIS, PC A03/MF A01.

31375 **(UH—511-187-75) Annual progress report of the high-energy physics group in the Department of Physics and Astronomy.** (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). 15 Nov 1974. Contract AC03-76ER00511. 100p. NTIS, PC A05/MF A01. Order Number DE81018985.

Research programs reported include: bubble-chamber neutrino physics at FNAL; external muon identifier; bubble-chamber film analysis; photon and neutron physics at FNAL; transition radiation; instrumentation and computation. (GHT)

31376 **Pion-induced single charge exchange and nuclear structure.** Oset, E. (Barcelona Univ. (Spain). Dept. de Fisica Teorica); Strottman, D. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). *Nuclear Physics* [*Section*] *A ;* **355**: No. 2, 437-476(9 Mar 1981).

The influence of nuclear structure upon calculated angular distribution and cross sections of pion-induced single charge exchange on light nuclei is studied within the framework of Glauber theory. Results obtained using simple shell-model configurations as well as more realistic shell-model wave functions which involve particle-hole components where appropriate are compared. In all cases the use of better wave functions enhance the (π^+,π^0) cross sections and suppress (π^-,π^0) cross sections. The effects of using realistic single-particle wave functions generated from Woods-Saxon potentials and the effects of the antisymmetry of the nuclear wave functions are also investigated. Renormalization of the properties of the Δ(3/2,3/2) in the nucleus has also been considered and is shown to be essential to understand the behaviour of the experimental integrated cross section. Results are given for (π^+,π^0) on ^{7}Li, ^{13}C, ^{15}N, ^{16}O, ^{17}O and ^{39}K and (π^-,π^0) on ^{13}C, ^{15}N and ^{17}O leading to the ground state and excited states of the final nucleus. A comparison with experiment is made where possible.

31377 **Charge exchange, hypercharge exchange, and baryon exchange reactions.** Moffeit, K.C. (Stanford Linear Accelerator Center, CA (USA)). pp 11-16 of Proceedings of the 19th international conference on high energy physics. Homma, S. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study); Kawaguchi, M.; Miyazawa, H. (eds.). Tokyo, Japan; Physical Society of Japan (1979).

From 19. conference on high energy physics; Tokyo, Japan (23 Aug 1978).

The experimental tests of exchange degeneracy (EXD) are described. Data were provided by line reversed reactions. For the Σ^+ production reactions, differential cross-sections and polarizations show agreement with the predictions of weak EXD. The 10 GeV data show similar behavior, whereas at larger momentum transfer, small EXD violation is seen. The mirror polarization supports weak EXD. The invariant mass distribution of the $\pi^+\Lambda$ system from both π^+ and K^- induced reactions shows a prominent peak due to Y* (1385) production. SLAC and Imperial College measured for the first time in one detector the complete decay angular distribution on $Y^* \rightarrow \Lambda\pi$, $\Lambda \rightarrow P\pi^-$ in the π^+P and K^-P line reversed reactions. The results for the four measurable transversity amplitudes were compared with the predictions of the additive quark model and Stodolski-Sakurai model. In general, the data agree with these predictions. The unnatural parity K exchange is allowed in the reaction $\pi^+P \rightarrow K^*(890)\,Y^+$ and $K^-P \rightarrow (\text{rho})^-\,Y^+$ where Y^+ is either Σ^+ and/or a Y* (1385). The SLAC-Imperial College data at 7 and 11.5 GeV/C find similar behavior for the vector meson and pseudoscalar production. Namely, the Σ^+ production is forward peaked, the Y* (1385) shows turnover in the forward direction. The results suggest that the K* and K* * exchanges dominate the vector meson production, and the K-exchange is weak. The differential cross-section of the reaction $K^-P \rightarrow \pi^0\Lambda$ (1520) at 4.2 GeV/C shows turnover in the forward direction, suggesting dominance of helicity flip amplitudes as in Y* (1385) production. Charge exchange reactions and baryon exchange reactions are discussed.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 31396

31378 **Pion photoproduction and the optical potential.** Haxton, W.C. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). *Physics Letters,* [*Section*] *B ;* **92**: No. 1/2, 37-40(May 1980).

The sensitivity of photopion nuclear reactions to the optical potential is examined.

31379 **(DOE/ET/05007—16) Calculation of cosmic ray antiproton-proton ratio.** Gaisser, T.K.; Mauger, B.G. (Delaware Univ., Newark (USA). Bartol Research Foundation; New Mexico State Univ., Las Cruces (USA). Physical Science Lab.). 1980. Contract AS02-78ER05007. 2p. (CONF-8009168—1). NTIS, PC A02/MF A01. Order Number DE81026287.

From Conference on cosmic ray astrophysics and low energy gamma-ray astronomy; Minneapolis, MN, USA (3 Sep 1980).

Cross section parameterizations for antiproton production in pp collisions are used to predict the antiproton/proton ratio resulting from a flux of cosmic protons with energy spectral index of 2.6 interacting with a 5 gm/cm^2 column density of H. (GHT)

31380 (LA—8879-MS) Comment on S-matrix parameterizations in NN-scattering. Mulders, P.J. (Los Alamos National Lab., NM (USA)). Aug 1981. Contract W-7405-ENG-36. 4p. NTIS, PC A02/MF A01. Order Number DE81027934.

The parameterization of the S-matrix used for the elastic part of the NN-scattering matrix in, for example, the Virginia Polytechnic Institute ineractive nucleon-nucleon program SAID, is not general enough to parameterize any 2 by 2 submatrix of a unitary matrix.

31381 Neutron weak spin rotation: Exotic nuclear physics or a new weak force. Stodolsky, L. (Stanford Linear Accelerator Center, CA (USA); Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Inst. fuer Physik). *Physics Letters, [Section] B ;* **96**: No. 1/2, 127-131(20 Oct 1980).

First observations of neutron weak spin rotation have found an effect much greater than anticipated on conventional weak interaction theory. An explanation might be found in special circumstances involving a weak low energy resonance in (n + ^{117}Sn). The possibility of a new weak force if conventional arguments fail is considered and tests of the various interpretations are proposed.

31382 (ORO—5126-140) Program TDIFFUSE. Boneh, Y.; Dworzecka, M.; Kan, K.K.; Griffin, J.J. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jul 1981. Contract AS05-76ER05126. 27p. NTIS, PC A03/MF A01. Order Number DE81028455.

A program written for the Univac 1108 to obtain the distribution in N and Z in a deep inelastic collision is described. The equations employed by the program to calculate the values of the dissipated energies and the resulting distribution are formulated. A prospective user should find here the needed instructions for executing the program, or changing one or more of its several subroutines.

31383 Model for the generation of leptonic mass. II. Fryberger, D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC-3-76SF00515. *Physical Review [Section] D: Particles and Fields ;* **24**: No. 4, 979-998(15 Aug 1981).

An analysis of a model for the generation of leptonic mass that considered only symmetric solutions is extended to include the possibility of asymmetric solutions. This possibility arises from a breakdown of a permutation symmetry between muon and electron. This broken symmetry also furnishes in a natural way a quantum number which distinguishes muons from electrons. A numerical study of the solutions of the extended model is performed, and it is shown that indeed their structure has a region with asymmetric solutions. The observed μ-e mass ratio lies within the range of estimates using this model, but the mass-splitting estimates thus obtained are seen to be very sensitive to computational errors as well as assumptions about unknown non-QED physics. The reasons for this sensitivity and sources of these errors are discussed. By an extrapolation of the model beyond the tau, a new yet heavier lepton is predicted, and a comparison is made to those predicted by some other models. Experimental tests of these predictions shoud be possible using coming generations of accelerators.

6453 Particle Invariance Principles And Symmetries

31384 (AD-A—091800) Gauge theories and spontaneous symmetry breaking. Final report, 1 November-15 December 1979. Sattinger, D.H.; Weaver, O.L. (Minnesota Univ., Minneapolis (USA). School of Mathematics). Nov 1980. Contract DAAG29-79-M-0125. 46p. NTIS, PC A03/MF A01.

This report summarizes attempts to understand in what way spontaneous symmetry breaking arose in the context of gauge field theories of elementary particles. The main interest was in knowing whether techniques of bifurcation theory could be applied to the problem of spontaneous symmetry breaking in gauge field theories. It was felt that the symmetry breaking used by the physicists (a procedure known as the Higgs mechanism) is not precisely a bifurcation problem in the usual sense of the term, but more a matter of fixing a gauge and thereby reducing the amount of symmetry of the problem. In other words, it is not really a matter of 'spontaneous' symmetry breaking.

31385 (CONF-8006136—2) Parity violation in nuclei. Robertson, R.G.H. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 20p. NTIS, PC A02/MF A01. Order Number DE81023420.

From International conference on neutrino physics and astrophysics; Erice, Trapani, Italy (23 Jun 1980).

A summary of parity violating effects in nuclei is given. Thanks to vigorous experimental and theoretical effort, it now appears that a reasonably well-defined value for the weak isovector π-nucleon coupling constant can be obtained. There is one major uncertainty in the analysis, namely the M2/E1 mixing ratio for the 2.79 MeV transition in ^{21}Ne. This quantity is virtually impossible to calculate reliably and must be measured. If it turns out to be much larger than 1, then a null result in ^{21}Ne is expected no matter what the weak interaction, so an experimental determination is urgently needed. The most promising approach is perhaps a measurement of the pair internal conversion coefficient. Of course, a direct measurement of a pure isovector case is highly desirable, and it is to be hoped that the four $\Delta T = 1$ experiments will be pushed still further, and that improved calculations will be made for the ^{6}Li case. Nuclear parity violation seems to be rapidly approaching an interesting and useful synthesis.

31386 (DOE/ER/01764—T2) Experimental and theoretical high energy physics. Progress report, October 1, 1980-June 30, 1981. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1981. Contract AC02-76ER01764. 46p. NTIS, PC A03/MF A01. Order Number DE81029024.

The high energy physics program at the University of Minnesota is reviewed. The Soudan 1 baryon decay experiment was converted from a concept demonstrated by a small prototype into a working experiment, which has already yielded interesting data about underground cosmic ray events. Fermilab E-629 acquired data on direct photon production in pion-nucleus and proton-nucleus collisions. Preliminary analysis of that experiment indicates a signal for direct photon events at transverse momenta as large as 4 GeV/c. The hyperon program continued its very fruitful studies of both the mechanisms for inclusive hyperon polarization and precision measurements of the hyperon magnetic moments with analyses of data from both Fermilab and Brookhaven experiments.

6454 Field Theory

REFER ALSO TO CITATION(S) 31383, 31436

31387 Unification of elementary forces. Gaillard, M.K. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Comments on Nuclear and Particle Physics ;* **9**: No. 2, 39-47(Apr 1980).

It has been suggested that strong, electromagnetic and weak interactions are all derivable from the coupling of massless vector bosons to conserved matter currents. Recent quantitative investigations of this striking similarity among the three basic forces of particle physics which is very suggestive of a single unified interaction are considered.

31388 (BNL—29769) Have we found Asymptopia: the ultimate form of physical laws. Lindenbaum, S.J. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA)). 1981. Contract AC02-76CH00016. 25p. (CONF-810376—4). NTIS, PC A02/MF A01. Order Number DE81028853.

From 16. rencontre de moriond: nonperturbative QCD: theory and experiment; Les Arcs, France (15 Mar 1981).

The search for Asymptopia - a high enough energy region - where the ultimate form of physical laws are revealed is described. The author considers the question, Have we found Asymptopia.

31389 **(DOE/ER/01545—309) Pattern of neutrino mixing in grand unified theories.** Milton, K.; Tanaka, K. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1981. Contract AC02-76ER01545. 9p. NTIS, PC A02/MF A01. Order Number DE81029034.

It was found previously in SO(10) grand unified theories that if the neutrinos have a Dirac mass and a right-handed Majorana mass ($\sim 10^{15}$GeV) but no left-handed Majorana mass, there is small ν/sub e/ mixing but ν/sub μ/ - ν/sub tau/ mixing can be substantial. This problem is reexamined on the basis of a formalism that assumes that the up, down, lepton, and neutrino mass matrices arise from a single complex 10 and a single 126 Higgs boson. This formalism determines the Majorana mass matrix in terms of quark mass matrices. Adopting three different sets of quark mass matrices that produce acceptable fermion mass ratios and Cabbibo mixing produces results consistent with the above; however, in the optimum case, ν/sub e/ - ν/sub μ/ mixing can be of the order of the Cabbibo angle.

31390 **(DOE/ER/03992—442) Gauge-theory ghosts and ghost-gauge theories.** Ne'eman, Y. (Tel Aviv Univ. (Israel); Texas Univ., Austin (USA)). 1981. Contract AS05-76ER03992. 22p. NTIS, PC A02/MF A01. Order Number DE81026749.

The geometric unitarity equations for an Internal gauge theory, for a supergauge, for the Kalb Ramond field, and for a Non-Internal gauge are reviewed. Recent results relating to the role of antighosts are presented.

31391 **Monte Carlo study of SU(2) Yang-Mills theory at finite temperature.** McLerran, L.D.; Svetitsky, B. (Stanford Linear Accelerator Center, CA (USA)). *Physics Letters,* [*Section*] *B ;* **98**: No. 3, 195-198(8 Jan 1981).

We employ Monte Carlo methods to study SU(2) Yang-Mills theory in the absence of fermions, on a lattice, at finite temperature. We determine the temperature at which a second-order transition takes place between confined and unconfined phases, in terms of the string tension.

31392 **(LBL—12893) Nuclear slab collision in a relativistic quantum field theory.** Mueller, K.H. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 10p. (CONF-8105104—3). NTIS, PC A02/MF A01. Order Number DE81028132.

From 5. high energy heavy ion study; Berkeley, CA, USA (18 May 1981).

The relativistic mean field model proposed by J.D. Walecka was recently used with great success to describe the properties of nuclear matter as well as the structure of the finite static nuclei. Starting from Walecka's Lagrangian the nucleons are represented by single particle spinors, which are determined by a Dirac equation containing a repulsive mean neutral vector field V/sub μ/ and an attractive mean isoscalar field σ. Both fields satisfy Klein-Gordon equations. Their source terms are again determined by the spinors. This relativistic mean field model was applied to the dynamics of two colliding slabs. They are translational invariant in two transverse dimensions and consist of spin and isospin symmetric nuclear matter. By specification of appropriate initial conditions for the collision of two equal slabs, the system of coupled Klein-Gordon-Dirac equations was solved for lab bombarding energies per nucleon up to 400 MeV. At low energies the results are identical with TDHF results. The damping of the collision, the phenomenon of high nuclear density, and the effect of retardation during the reaction are studied.

31393 **(PB—81-115008) High temperature expansions for the free energy of vorticies respectively the string tension in lattice gauge theories.** Muenster, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). May 1980. 28p. NTIS, PC A03/MF A01.

High temperture cluster expansions are derived for the free energy of vortices in SU(2) and Z2 lattice gauge theories in 3 and 4 dimensions. The expected behavior of the vortex free energy is verified. It obeys an area law behavior. The coefficient of the area is shown to be equal to the string tension between static quarks. Its expansion is calculated up to the 12th order. For SU(2) in 4 dimensions, the result is compared with Monte Carlo calculations of Creutz and is in good agreement at strong and intermediate coupling.

31394 **Cosmic strings in unified gauge theories.** Everett, A.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Physical Review* [*Section*] *D: Particles and Fields ;* **24**: No. 4, 858-868(15 Aug 1981).

Some spontaneously broken gauge theories can give rise to stringlike vacuum structures (vortices). It has been pointed out by Vilenkin that in grand unified theories these can be sufficiently massive to have cosmological implications, e.g., in explaining the formation of galaxies. The circumstances in which such structures occur are examined. They do not occur in the simplest grand unified theories, but can occur in some more elaborate models which have been proposed. The cross section for the scattering of elementary particles by strings is estimated. This is used to evaluate the effect of collisions on the dynamics of a collapsing circular string, with particular attention to the question of whether energy dissipation by collision can reduce the rate of formation of black holes by collapsed strings, which may be unacceptably large in models where strings occur. It is found that the effect of collisions is not important in the case of grand unified strings, although it can be important for lighter strings.

31395 **Monte Carlo simulations of systems with fermions.** Hamber, H.W. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Physical Review* [*Section*] *D: Particles and Fields ;* **24**: No. 4, 951-959(15 Aug 1981).

We present results of a Monte Carlo evaluation of the path integral for two-dimensional theories with fermions. These include fermions coupled to scalar fields and fermions coupled to Abelian gauge bosons. On a 10 by 10 lattice we have computed expectation values of local operators and correlation functions, from which we have estimated mass gaps. In the case of the coupled gauge-fermion system we find dynamical mass generation for both fermions and gauge bosons. We discuss the phase diagram and the continuum limit of the theory.

31396 **Evidence for large-x corrections in quantum chromodynamics.** Barnett, R.M.; Schlatter, D.; Trentadue, L. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Physical Review Letters ;* **46**: No. 26, 1659-1662(29 Jun 1981).

We show there is evidence that a method of summing important logarithmic corrections which are significant in the large-x region leads to a superior description of deep-inelastic scattering data (analyzed using the evolution equations). Next-to-leading-order calculations can imitate the impact of this summation method, but at high x it appears that there are higher-order and higher-twist corrections which separate those approaches.

31397 **Three-loop β-functions of non-linear sigma models on symmetric spaces.** Hikami, S. (Kyoto Univ. (Japan). Research Inst. for Fundamental Physics; Brookhaven National Lab., Upton, NY (USA)). *Physics Letters,* [*Section*] *B ;* **98**: No. 3, 208-210(8 Jan 1981).

It is shown that the renormalization group β-functions of the two-dimensional nonlinear sigma models on various symmetric spaces are determined up to three-loop order by the isomorphic relations between the classical groups.

31398 **Monte Carlo simulations of lattice gauge theories.** Rebbi, C. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.). *Physics Reports: A Review Section of Physics Letters (Section C) ;* **67**: No. 1, 55-62(Dec 1980).

I shall describe Monte Carlo simulations done for four-dimensional lattice gauge systems, where the gauge group is one of the following: i) U(1); ii) SU(2); iii) Zsub(N), i.e., the subgroup of U(1) consisting of the elements $\exp(2\pi in/N)$ with integer n and N; iv) the eight-element group of quaternions, Q; v) the 24- and 48-element subgroups of SU(2), denoted by T and O, which reduce to the rotation groups of the tetrahedron and the octahedron when their centers, Z_2, are factored out.

31399 Gravitation, gauge theories and differential geometry. Eguchi, T. (Stanford Linear Accelerator Center, CA (USA); Chicago Univ., IL (USA). Enrico Fermi Inst.; Chicago Univ., IL (USA). Dept. of Physics); Gilkey, P.B. (Princeton Univ., NJ (USA). Dept. of Mathematics; California Univ., Los Angeles (USA). Dept. of Mathematics); Hanson, A.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Physics Reports: A Review Section of Physics Letters (Section C) ;* **66**: No. 6, 215-393(Dec 1980).

The purpose of this article is to outline various mathematical ideas, methods, and results, primarily from differential geometry and topology, and to show where they can be applied to Yang-Mills gauge theories and Einstein's theory of gravitation.We have several goals in mind. The first is to convey to physicists the bases for many mathematical concepts by using intuitive arguments while avoiding the detailed formality of most textbooks. Although a variety of mathematical theorems will be stated, we will generally give simple examples motivating the results instead of presenting abstract proofs. Another goal is to list a wide variety of mathematical terminology and results in a format which allows easy reference. The reader then has the option of supplementing the descriptions given here by consulting standard mathematical references and articles such as those listed in the bibliography. Finally, we intend this article to serve the dual purpose of acquainting mathematicians with some basic physical concepts which have mathematical ramifications; physical problems have often stimuladed new directions in mathematical thought.

31400 Evidence that hadronic interiors have a denser matter than charge distribution. Miettinen, H.I. (Fermi National Accelerator Lab., Batavia, IL (USA)); Thomas, G.H. (Argonne National Lab., IL (USA). High Energy Physics Div.). *Nuclear Physics [Section] B ;* **166**: No. 3, 365-377(Apr 1980).

An analysis of high-energy elastic and inelastic diffraction scattering provides strong evidence that the charge and matter densities of hadrons are different. When hadrons are treated as composite objects, then a correct Glauber analysis leads to an optical model with important corrections due to the hadronic wave function: One expects inelastic diffraction due to the fluctuations in the matter density of hadrons. Conversely, the experimental existence of dissociation processes gives phenomenological information about the hadronic wave function. We find the distribution of matter in nucleons to be denser than the observed charge distribution. This result has a natural interpretation from a constituent description of hadrons made from spin 1/2 quarks and colored vector gluons, which is a generalization of the Chou-Yang picture of diffraction scattering.

31401 (DOE/ER/13065—T4) Canonical quantization of some dissipative systems and non-uniqueness of Lagrangians (revised). Okubo, S. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). [nd]. Contract AC02-76ER13065. 31p. NTIS, PC A03/MF A01. Order Number DE81025918.

Some one-dimensional dissipative systems can be found to admit canonical quantization procedure, contrary to opinions expressed occassionally in the literature. Also, a natural way of quantizing an equation $q + V(q) = 0$ for a function $V(q)$ is found to use a non-standard commutation relation $[q,\pi] = i\hbar\pi$ together with Hamiltonian $H = \pi + V(q)$. Here, $\pi = q$ stands for velocity operator rather than the momentum operator. Finally, a quantization problem of a Newtonian geodesic equation of motion in non-flat space is discussed.

6455 Scattering Theory

31402 (DOE/ER/70019—T17) Time-dependent scattering processes and invariant imbedding. Bellman, R. (University of Southern California, Los Angeles (USA)). Oct 1970. Contract AT03-76ER70019. 18p. NTIS, PC A02/MF A01. Order Number DE81026101.

31403 Two distinct local potentials with no bound states can have the same scattering operator. A nonuniqueness in inverse spectral transformations. Abraham, P.B.; DeFacio, B.; Moses, H.E. (Naval Underwater Systems Center, New London, Connecticut 06385). W-7405-ENG-82. *Physical Review Letters ;* **46**: No. 26, 1657-1659(29 Jun 1981).

By giving an explicit example in one dimension, it is shown that by relaxing a condition on the ranges, at least two potentials can have the same scattering operator in some cases. The two potentials are local and do not support point eigenvalues. The implications for solutions of the Korteweg—de Vries equation are briefly discussed.

65 PHYSICS RESEARCH

6510 Nuclear Physics

31404 (DOE/ER/05034—4) Experimental nuclear physics. Progress report, September 1980-June 1981. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy). 1981. Contract AS05-76ER05034. 135p. NTIS, PC A07/MF A01. Order Number DE81026983.

Continuing cooperative research is reported in the areas of, a) In-beam γ-ray spectroscopy with scientists at Oak Ridge and the University of Koeln; b) Coulomb excitation studies at Lawrence Berkeley Laboratory and at GSI, Darmstadt, Germany; c) Maxsive transfer and preequilibrium emission processes in fusion reactions at ORNL; d) Nucleon transfer reaction studies with scientists at ORNL, Los Alamos and Brookhaven; e) δ-electron spectroscopy at the Mas Planck Institute in Heidelberg; f) Heavy ion atomic physics at the ORNL En tandem; g) Studies of nuclei far from stability at UNISOR; and h) Theoretical studies of high spin phenomena with scientists at Lawrence Berkeley, Brookhaven Lab., Univ. of Tubingen, and Copenhagen and of nuclear molecules and their decay processes in very heavy ion collisions with the University of Frankfurt and Vanderbilt theorists. Abstracts of papers published or submitted for publication are presented, and brief reports of work in process are given.

31405 (DOE/ER/10335—3) Research in nuclear physics. Progress report, August 1, 1980-July 31, 1981. Kozub, R.L. (Tennessee Technological Univ., Cookeville (USA). Dept. of Physics). 1981. Contract AS05-79ER10335. 32p. NTIS, PC A03/MF A01. Order Number DE81028913.

Separate abstracts were prepared for the three summary papers presented. Research activities by TTM personnel including publications, conference papers, abstracts of talks given at APS meetings, student papers presented at SPS meetings, and papers submitted for publication are listed. (WHK)

31406 (EGG-PHYS—5469) New RAFFLE cross-section libraries incorporating Version V materials. Millsap, D.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1981. Contract AC07-76ID01570. 35p. NTIS, PC A03/MF A01. Order Number DE81029060.

A completely new RAFFLE fast library has been processed using a substantially revised version of the processing code ENDRAFL. The new library contains predominantly ENDF/B Version V materials. The INCITE master library has also been updated with Version V materials where significant changes have been made since Version IV.

31407 Nuclear data sheets. Ramavataram, S.; Dunford, C.L. (Brookhaven National Laboratory, Upton, New York 11973). W-7405-ENG-26;DE-AC02-76CH00016. *Nuclear Data Sheets ;* **32**: No. 3, 369-495(Mar 1981).

References are given to literature received by the National Nuclear Data Center or assigned key numbers between January and April 1981. (AIP)

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 31417

31408 **(DOE/ER/40007—T1) Nuclear chemistry progress report.** Viola, V.E. Jr. (Indiana Univ., Bloomington (USA)). Aug 1981. Contract AC02-81ER40007. 60p. NTIS, PC A04/MF A01. Order Number DE81029023.

The following were studied: charge and mass variances in ^{56}Fe-induced reactions; ^{40}Ca + ^{37}Cl and ^{209}Bi + ^{37}Cl reactions at 270 MeV; production of exotic nuclei in ^{56}Fe-induced reactions; the ^{165}Ho + ^{56}Fe reaction at 462 MeV; pre-equilibrium emission of light ions in the reaction ^{16}O + ^{238}U at 20 MeV/u; prompt light-ion emission in the ^{238}U + ^{4}He reaction at 20- and 40-MeV/u; studies of the total reaction cross section in bombardments at ^{27}Al with 30 to 50 MeV/u ^{4}He ions; reaction mechanisms of alpha-particle-induced reactions on ^{12}C, ^{14}N and ^{16}O at 60 to 160 MeV; production of ^{6}He, ^{6}Li, ^{7}Li, and ^{7}Be in the α + α reaction between 60 to 160 MeV; search for asymmetric mass division in light fissioning systems; systematics of fission total kinetic energy release; and nucleosynthesis of the light elements Li, Be, and B.

6512 Nuclear Properties And Reactions, A=1-5

31409 **Theoretical estimates of the trineutron and tetraneutron binding energies.** Bevelacqua, J.J. (Department of Energy, Oak Ridge, TN (USA). Planning Div.). *Nuclear Physics [Section] A ;* **341**: No. 3, 414-420(Jun 1980).

The trineutron and tetraneutron binding energies are calculated using an interaction which reproduces ^{3}H, ^{3}He, ^{4}H, ^{4}He, and ^{4}Li ground-state properties. A 4 h/2$\pi\omega$ model space and completely symmetrized translationally invariant harmonic oscillator eigenstates are used in the analysis. The calculation yields a ^{3}n eigenvalue within the range suggested in an experiment by Ohlsen et al. The ^{4}n eigenvalue is consistent with the location of the first T = 2 level in the ^{4}He system.

31410 **Shell-model calculations in the A = 5 system.** Bevelacqua, J.J. (Department of Energy, Oak Ridge, TN (USA). Planning Div.). *Nuclear Physics [Section] A ;* **357**: No. 1, 126-138(30 Mar 1981).

The A = 5 structure problem is solved within the framework of the nuclear shell model. The model states are expanded on a basis of properly symmetrized translationally invariant harmonic oscillator eigenstates including states of up to 5h/2$\pi\omega$ of oscillator excitation. Ground and excited levels of the ^{5}H, ^{5}He, ^{5}Li and ^{5}Be systems are presented. The two-body interaction is based on the Sussex matrix elements. Model results are in good agreement with measured A = 5 level positions. The model T = 3/2 results lead to a quartet of levels, whose positions are given roughly by the isobaric multiplet mass equation.

31411 **Upper limits for bound states and resonance behavior in the trineutron system.** Miller, J.P.; Bistirlich, J.A.; Crowe, K.M.; Rosenblum, S.S.; Rowe, P.C.; Shively, F.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Grilly, E.R.; Kerr, E.C.; Novak, J.; Sherman, R.H. (Los Alamos Scientific Lab., NM (USA)). *Nuclear Physics [Section] A ;* **343**: No. 3, 347-355(Jul 1980).

The trineutron mass spectrum was observed in the stopped pion radiative capture reaction 3H(π^-,γ)3n by measuring the photon energy with a high-resolution spectrometer. The present experiment improves upon an earlier experiment by a factor of 27 in statistics and 2.2 in resolution. An improved upper limit (95% confidence level) on the branching ratio (bound state)/(total radiative capture rate) is found to be 4 x 10^{-3}. No resonant structure is observed beyond that predicted by the pairwise interaction of the outgoing nucleons. The upper limit on the branching ratio to resonances with GAMMA < approx. 5 MeV is 2 x 10^{-2}.

6513 Nuclear Properties And Reactions, A=6-19

31412 (DOE/ER/10335—3, pp 10-12) **Production of neutron-rich nuclei via reactions of ^{18}O with ^{14}C: electromagnetic transitions in ^{30}Al.** Kozub, R.L.; Olness, J.; Chitwood, C.B. Jr.; Fields, D.J.; Matthews, T.L. 1981. NTIS, PC A03/MF A01.

In Research in nuclear physics. Progress report, August 1, 1980-July 31, 1981.

A preliminary report of the first investigation of fusion-evaporation reactions between ^{18}O and ^{14}C nuclei is given. Gamma-ray yield curves were obtained for ^{18}O laboratory energies in the range 15 to 35 MeV, and some gamma-gamma coincidence data were taken at 25 MeV. The target was 106 μg/cm^2 ^{14}C on a 0.1 mil-thick Ni foil, which was clamped to a 1 mil-thick Ta foil to stop the beam. Gamma-ray singles events for yield curve data were detected with an n-type hyperpure Ge detector (nHPGe) of 11.5% relative efficiency placed at 90° to the beam. The nHPGe detector was also inside an 8in x 10in NaI escape suppression spectrometer (ESS). Coincidence data were taken with the nHPGe detector and a second nHPGe detector of 18.5% relative efficiency, both at 90° to the beam.

31413 (DOE/ER/10335—3, pp 13-25) **Systematics of the competition between pn and d emission in heavy-ion induced nuclear reactions.** Xenoulis, A.C. (Nuclear Research Center Demokritos, Greece); Aravantinos, A.E.; Lister, C.J.; Olness, J.W.; Kozub, R.L. 1981. NTIS, PC A03/MF A01.

In Research in nuclear physics. Progress report, August 1, 1980-July 31, 1981.

The competition between pn and d evaporation leading to production of the same residual nuclei has been measured for several heavy-ion induced nuclear reactions. γ rays were measured in coincidence with a ΔE-E telescope for 9 reactions, each at several bombarding energies, for target-projectile combinations resulting in compound nuclei 19 < A < 71. An association of the ratio σ/sub pn/sigma/sub d/ with the maximum excitation energy available to the residual nucleus demonstrates a systematic trend, the significance and potential applications of which are investigated.

6514 Nuclear Properties And Reactions, A=20-38

REFER ALSO TO CITATION(S) 31412, 31413

31414 (DOE/ER/10335—3, pp 4-9) **Recoil distance measurements of litetimes of levels in ^{21,20}F and ^{16}N.** Kozub, R.L.; Mateja, J.F.; Lin, J.; Lister, C.J.; Olness, J.; Warburton, E.K.; Bynum, M.R.; Matthews, T.L. 1981. NTIS, PC A03/MF A01.

In Research in nuclear physics. Progress report, August 1, 1980-July 31, 1981.

The previously-reported measurements of meanlives of ^{20,21}F levels using the recoil-distance method (RDM) and ^{18}O + ^{7}Li reactions have been repeated using improved experimental techniques. In addition, the lifetimes of two ^{16}N levels were measured, using the same experimental setup and ^{11}B + ^{7}Li reactions. Data were taken using the BNL precision plunger, in which were mounted a stretched Ta stopper foil (~ 20 /sub cm^2//sup mg/ thick) and a 300 μg/cm^2 - thick Li target condensed onto a stretched, 1.4 mg/cm^2 - thick Ta backing. Changes in target-to-stopper distance (d) could be controlled to an accuracy of about +- 1 μm, and were monitored by measuring target-to-stopper capacitance (C).

6516 Nuclear Properties And Reactions, A=59-89

REFER ALSO TO CITATION(S) 31413, 31414

6517 Nuclear Properties And Reactions, A=90-149

REFER ALSO TO CITATION(S) 31381

6518 Nuclear Properties And Reactions, A=150-189

REFER ALSO TO CITATION(S) 31416

6519 Nuclear Properties And Reactions, A=190-219

31415 Is the concept of a mean free path relevant to nucleons in nuclei. DeVries, R.M.; DiGiacomo, N.J. (Los Alamos Scientific Lab., NM (USA)). *Journal of Physics G: Nuclear Physics ;* **7**: No. 4, L51-L54(Apr 1981).

Realistic nucleon mean free paths in ^{12}C and ^{208}Pb nuclei are computed by including the effects of Fermi motion, Pauli blocking and the Coulomb and nuclear interaction potentials. These local, i.e. radius-dependent, mean free paths can differ enormously from the nuclear matter value. The meaning of a mean free path in finite nuclei is discussed and an alternative quantity, the absorption probability as a function of impact parameter, is defined.

6520 Nuclear Properties And Reactions, A=220 And Above

31416 (EGG-M—02581) Identification of new neutron-rich rare-earth nuclei produced in ^{252}Cf spontaneous fission. Greenwood, R.C.; Gehrke, R.J.; Baker, J.D.; Meikrantz, D.H. (Idaho National Engineering Lab., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 15p. (CONF-810649—14). NTIS, PC A02/MF A01. Order Number DE81028279.

From 4. international conference on nuclei far from stability; Helsignor, Denmark (7 Jun 1981).

A program of systematic study of the decay properties of neutron-rich rare-earth nuclei with 30 s < t/sub 1/2/ < 10 min, produced in ^{252}Cf spontaneous fission, is currently underway using the Idaho ESOL (Elemental Separating On Line) Facility. The chemistry system used for the rare earth elemental separations consists of two high-performance chromatography columns connected in series and coupled to the ^{252}Cf fission source via a helium gas-jet transport arrangement. The time delay for separation and initiation of γ-ray counting with this system is typically 2 to 3 min. Significant results which have been obtained to date with this system include the identification of a number of new neutron-rich rare-earth isotopes including ^{155}Pm (t/sub 1/2/ = 48 +- 4 s) and ^{163}Gd (t/sub 1/2/ = 68 +- 3 s), in addition to 5.51 min ^{158}Sm which was identified in an earlier series of experiments.

31417 (EGG-M—02681) Development of a gas-jet coupled ISOL facility with a ^{252}Cf spontaneous fission source. Greenwood, R.C.; Anderl, R.A.; Novick, V.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 7p. (CONF-810649—13). NTIS, PC A02/MF A01. Order Number DE81028100.

From 4. international conference on nuclei far from stability; Helsignor, Denmark (7 Jun 1981).

A mass separator at the INEL has been successfully coupled on-line to a source of ^{252}Cf fission products via a He-gas jet transport arrangement using solid aerosols of NaCl as activity carriers. Initial tests of the ISOL system on-line to an $\sim$ 7 μg ^{252}Cf source were conducted using gamma-ray spectroscopic measurements of the separated /sup 138,139/Cs, /sup 141,142/Ba and ^{142}La activities. The measured transport efficiencies through the system of $\sim$ 3% and $\sim$ 0.3% for the Cs and Ba isotopes, respectively, are comparable with the results of earlier tests conducted at INEL with a hollow-cathode ion source alone coupled to the He-gas jet transport arrangement. Following these tests, a general survey of the mass-separated activities was conducted with the ISOL system online to an $\sim$ 600 μg source of ^{252}Cf. Gross β-γ activity was measured for samples collected at 73 mass positions. Gamma-ray spectra were measured with a Ge(Li) detector for 29 of the mass positions. These survey experiments demonstrated the production of significant fission product activity in mass regions which are not available at other ISOL facilities.

6530 Nuclear Theory

31418 (LBL—12929) Central needs not mean collective. Bohrmann, S. (Lawrence Berkeley Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 7p. (CONF-8105104—1). NTIS, PC A02/MF A01. Order Number DE81027095.

From 5. high energy heavy ion study; Berkeley, CA, USA (18 May 1981).

Spectra of high momentum protons from high energy nuclear collisions are analyzed in terms of a simple statistical model: independently interacting groups of nucleons contribute incoherently. The nucleon momentum distributions within one group follow phase space. It can be shown that: (1) the spectra can clearly be decomposed into spectator and participant contributions; and (2) the average size of the nucleon groups is very insensitive to impact parameter restrictions. The latter finding suggests that (at least for the high momentum tails of measured spectra) central collisions do not necessarily enhance the chance for seeing indications of effects due to coherence in the interaction of a larger number of particles (collective effects).

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 30621, 31348

31419 (CONF-810707—6) Energy losses and mean free paths of electrons in silicon dioxide. Ashley, J.C.; Anderson, V.E. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01. Order Number DE81026353.

From IEEE conference on nuclear science and space radiation; Seattle, WA, USA (21 Jul 1981).

Theoretical models and calculations are combined with experimental optical data to determine a model energy-loss function for SiO_2. Sumrule checks and comparisons with experimental information are made to insure overall consistency of the model. The model energy-loss function is employed to calculate electron inelastic mean free paths and stopping powers for electrons with energies $\leqq$ 10 keV in SiO_2.

31420 (CONF-810840—1) QNS measurements on water in biological and model systems. Trantham, E.C.; Rorschach, H.E.; Clegg, J.C.; Hazlewood, C.F.; Nicklow, R.M. (Oak Ridge National Lab., TN (USA); Miami Univ., Coral Gables, FL (USA); Baylor Univ., Houston, TX (USA). Coll. of Medicine). 1981. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE81028576.

From Symposium on neutron scattering; Argonne, IL, USA (12 Aug 1981).

Results are presented on the quasi-elastic spectra of 0.95 THz neutrons scattered from pure water, a 20% agarose gel and cysts of the brine shrimp (Artemia) of hydration 1.2 gms H_2O per gm of dry solids. The lines are interpreted with a two-component model in which the hydration water scatters elastically and the free water is described by a jump-diffusion correlation function. The results for the line widths $\Gamma(Q^2)$ are in good agreement with previous measurements for the water sample but show deviations from pure water at large Q for agarose and the Artemia cysts that suggest an increased value of the residence time in the jump-diffusion model.

31421 (ORNL/TM—7882) HETFIS: High-Energy Nucleon-Meson Transport Code with Fission. Barish, J.; Gabriel, T.A.; Alsmiller, F.S.; Alsmiller, R.G. Jr. (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 29p. NTIS, PC A03/MF A01. Order Number DE81027674.

A model that includes fission for predicting particle production spectra from medium-energy nucleon and pion collisions with nuclei ($Z \geqq 91$) has been incorporated into the nucleon-meson transport code, HETC. This report is primarily concerned with the programming aspects of HETFIS (High-Energy Nucleon-Meson Transport Code with Fission). A description of the program data and instructions for operating the code are given. HETFIS is written in FORTRAN IV for the IBM computers and is readily adaptable to other systems.

6550 Medical Physics

REFER ALSO TO CITATION(S) 31128, 31259

31422 (DOE/EV/04733—T1, pp 43-47) **Effective anti q values for monoenergetic photons from 12 keV to 1200 keV.** Kliauga, P.; Rossi, H.H. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

It has been proposed that the quality factor, Q, be replaced by a new quality, q, whose definition is based on microdosimetric parameters. The LET concept is known to be inadequate for the description of effects which depend on the stochastics of energy deposition in small volumes. The microdosimetric distributions can be directly measured with current proportional counter techniques. LET distributions cannot be readily measured, and can be derived from microdosimetric data only with limited accuracy. For this reason a microdosimetric parameter seems to be a more reasonable choice than LET. The parameter selected is the saturation-corrected lineal energy which is defined in reference to the effective anti q value. This quantity can be readily calculated from a measured or calculated microdosimetric spectrum. In this paper the microdosimetric spectra of monoenergetic photons ranging from 12 keV to 1200 keV have been measured at our laboratory with a wall-less counter.

31423 (DOE/EV/04733—T1, pp 48-66) **Studies with encapsulated ^{125}I sources: dosimetry for determination of relative biological effectiveness.** Goldhagen, P.; Freeman, M.L.; Hall, E.J. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

During the past year, members of this laboratory have measured the Relative Biological Effectiveness (RBE) of photons from encapsulated ^{125}I sources (mean energy = 28.33 keV) using 661.6 keV ^{137}Cs gamma rays as a standard for comparison. These experiments were performed at clinically relevant dose rates and used reduction of the reproductive viability of mammalian cells as an endpoint. This section will discuss how dosimetry problems special to ^{125}I influence the design of the apparatus and will describe the ionization chamber to be used for measuring dose rates from both ^{125}I and ^{137}Cs photons.

31424 **(DOE/TIC—11026) Radioactive decay data tables.** Kocher, D.C. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 228p. NTIS, PC A11/MF A01.

The estimation of radiation dose to man from either external or internal exposure to radionuclides requires a knowledge of the energies and intensities of the atomic and nuclear radiations emitted during the radioactive decay process. The availability of evaluated decay data for the large number of radionuclides of interest is thus of fundamental importance for radiation dosimetry. This handbook contains a compilation of decay data for approximately 500 radionuclides. These data constitute an evaluated data file constructed for use in the radiological assessment activities of the Technology Assessments Section of the Health and Safety Research Division at Oak Ridge National Laboratory. The radionuclides selected for this handbook include those occurring naturally in the environment, those of potential importance in routine or accidental releases from the nuclear fuel cycle, those of current interest in nuclear medicine and fusion reactor technology, and some of those of interest to Committee 2 of the International Commission on Radiological Protection for the estimation of annual limits on intake via inhalation and ingestion for occupationally exposed individuals.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 30912, 30953, 30979, 31000

31425 **(LA-UR—81-2303) Some techniques and results from high-pressure shock-wave experiments utilizing the radiation from shocked transparent materials.** McQueen, R.G.; Fritz, J.N. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 16p. (CONF-810684—44). NTIS, PC A02/MF A01. Order Number DE81028699.

From APS conference on shock waves in condensed matter; Menlo Park, CA, USA (23 Jun 1981).

It has been known for many years that some transparent materials emit radiation when shocked to high pressures. This property was used to determine the temperature of shocked fused and crystal quartz, which in turn allowed the thermal expansion of SiO_2 at high pressure and also the specific heat to be calculated. Once the radiative energy as a function of pressure is known for one material it is shown how this can be used to determine the temperature of other transparent materials. By the nature of the experiments very accurate shock velocities can be measured and hence high quality equation of state data obtained. Some techniques and results are presented on measuring sound velocities from symmetrical impact of nontransparent materials using radiation emitting transparent analyzers, and on nonsymmetrical impact experiments on transparent materials. Because of special requirements in the later experiments, techniques were developed that lead to very high-precision shock-wave data. Preliminary results, using these techniques are presented for making estimates of the melting region and the yield strength of some metals under strong shock conditions.

31426 **(SAND—81-1074C) Recent high-pressure Fermi-surface studies on $(TMTSF)_2PF_6$ and ReO_3.** Schirber, J.E. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 14p. (CONF-810828—3). NTIS, PC A02/MF A01. Order Number DE81025468.

From Conference on high pressure physics; Bad Honnef, F.R. Germany (Aug 1981).

Hydrostatic pressure coupled with temperatures near absolute zero has proven to be an extremely important environment in the study of the Fermi surface and electronic structure of metals. This environment allows critical testing of theoretical models for the electronic structure and allows access to regions of the phase diagram of the material where interesting and desirable properties may be isolated and studied. Two recent examples of the latter type of study are reviewed involving the compressibility collapse transition in ReO_3 and quantum oscillatory behavior at high-magnetic fields in $(TMTSF)_2PF_6$. 11 figures.

31427 **(UCID—19156) User's manuals for DYNA3D and DYNAP: nonlinear dynamic analysis of solids in three dimensions.** Hallquist, J.O. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 96p. NTIS, PC A05/MF A01. Order Number DE81028360.

This report provides a user's manual for DYNA3D, an explicit three-dimensional finite element code for analyzing the large deformation dynamic response of inelastic solids. A contact-impact algorithm permits gaps and sliding along material interfaces. By a specialization of this algorithm, such interfaces can be rigidly tied to admit variable zoning without the need of transition regions. Spatial discretization is achieved by the use of 8-node solid elements, and the equations-of-motion are integrated by the central difference method. Post-processors for DYNA3D include GRAPE for plotting deformed shapes and stress contours and DYNAP for plotting time histories. A user's manual for DYNAP is also provided in this report.

31428 **(UCRL—85778) Monte Carlo calculations of channeling radiation.** Bloom, S.D.; Berman, B.L.; Hamilton, D.C.; Alguard, M.J.; Barrett, J.H.; Datz, S.; Pantell, R.H.; Swent, R.H. (Lawrence Livermore National Lab., CA (USA); Measurex Corp., Cupertino, CA (USA); Oak Ridge National Lab., TN (USA); Stanford Univ., CA (USA). Dept. of Electrical Engineering). 1981. Contract W-7405-ENG-48. 19p. (CONF-810728—4). NTIS, PC A02/MF A01. Order Number DE81027655.

From 9. international conference on atomic collisions in solids; Lyon, France (6 Jul 1981).

Results of classical Monte Carlo calculations are presented for the radiation produced by ultra-relativistic positrons incident in a direction parallel to the (110) plane of Si in the energy range 30 to 100 MeV. The results all show the characteristic CR(channeling radiation) peak in the energy range 20 keV to 100 keV. Plots of the centroid energies, widths, and total yields of the CR peaks as a function of energy show the power law dependences of $\gamma^{1.5}$, $\gamma^{1.7}$, and $\gamma^{3.5}$ respectively. Except for the centroid energies and power-

law dependence is only approximate. Agreement with experimental data is good for the centroid energies and only rough for the widths. Adequate experimental data for verifying the yield dependence on γ does not yet exist.

31429 **(UCRL—86485) Electron band theory and high pressure equation of state.** McMahan, A.K. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 21 Jul 1981. Contract W-7405-ENG-48. 8p. (CONF-810827—3). NTIS, PC A02/MF A01. Order Number DE81027436.

From 8. AIRAPT conference and 19. EHPRG conference; Uppsala, Sweden (17 Aug 1981).

Calculations of the high pressure equation of state of selected materials are reviewed, in order to illustrate general trends which occur in the evolution of electronic structure with compression, and the consequences of these trends for material properties.

31430 **Criteria for automatic x-ray absorption fine structure background removal.** Cook, J.W. Jr.; Sayers, D.E. (Department of Physics, North Carolina State University, Raleigh, North Carolina 27650). *Journal of Applied Physics ;* **52**: No. 8, 5024-5031(Aug 1981).

Criteria for terminating smoothing to remove a cubic spline background from the x-ray absorption coefficient are stated in terms of three parameters obtained from the k^3 weighted Fourier transform of the resulting x-ray absorption fine structure data. The three parameters are H/sub R/, the average value of the transform magnitude between 0 and 0.25 A, H/sub M/, the maximum value in the transform magnitude between 1 and 5 A, and H/sub N/, the average value of the transform magnitude between 9 and 10 A. The termination criteria are H/sub R/-H/sub N/ $>$ or $=$0.05H/sub M/ ; or if H/sub N/ $>$0.1H/sub M/, then H/sub R/ $>$ or $=$0.1H/sub M/. The incorporation of the criteria into a computer program to facilitate automatic background removal is discussed. Examples of application of the technique to copper, β-PtO_2, and ferritin samples are presented.

31431 **Full-potential self-consistent linearized-augmented-plane-wave method for calculating the electronic structure of molecules and surfaces: O_2 molecule.** Wimmer, E.; Krakauer, H.; Weinert, M.; Freeman, A.J. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). *Physical Review* [*Section*] *B: Condensed Matter ;* **24**: No. 2, 864-875(15 Jul 1981).

The linearized-augmented-plane-wave (LAPW) method for thin films is generalized by removing the remaining shape approximation to the potential inside the atomic spheres. A new technique for solving Poisson's equation for a general charge density and potential is described and implemented in the film LAPW method. In the resulting full-potential LAPW method (FLAPW), all contributions to the potential are completely taken into account in the Hamiltonian matrix elements. The accuracy of the method: already well known for clean metal surfaces: is demonstrated for the case of a nearly free (noninteracting) O_2 molecule which is a severe test case of the method because of its large anisotropic charge distribution. Detailed comparisons show that the accuracy of the FLAPW results for O_2 exceeds that of existing state-of-the-art local-density linear-combination-of-atomic-orbitals (LCAO)-type calculations, and that taking the full potential LAPW results as a reference, the LCAO basis can be improved by adding off-site functions. Thus the full-potential LAPW is a unified method which is ideally suited to test not only molecular adsorption on surfaces, but also the components of the same system separately, i.e., the extreme limits of the molecule and the clean surface.

31432 **Dynamics of a two-dimensional order-disorder transition.** Sahni, P.S.; Dee, G.; Gunton, J.D.; Phani, M.; Lebowitz, J.L.; Kalos, M. (Physics Department, Temple University, Philadelphia, Pennsylvania 19122). DE-AC02-76ER3077. *Physical Review* [*Section*] *B: Condensed Matter ;* **24**: No. 1, 410-418(1 Jul 1981).

We present results of a Monte Carlo study of the time development of a two-dimensional order-disorder model binary alloy following a quench to low temperature from a disordered, high-temperature state. The behavior is qualitatively quite similar to that seen in a recent study of a three-dimensional system. The structure function exhibits a scaling of the form $K^2(t)S(k,t) = G(k/K(t))$ where the moment K(t) decreases with time approximately like t/ sup -1/2/. If one interprets this moment as being inversely proportional to the domain size, the characteristic domain growth rate is proportional to t/sup -1/2/. Additional insight into this time evolution is obtained from studying the development of the short-range order, as well as from monitoring the growth of a compact ordered domain embedded in a region of opposite order. All these results are consistent with the picture of domain growth as proposed by Lifshitz and by Cahn and Allen.

31433 **Amplitude-dependent internal friction calculations for dislocations in alloys.** Schwarz, R.B. (Argonne Natl Lab, Ill). *Acta Metallurgica ;* **29**: No. 2, 311-323(Feb 1981).

The amplitude-dependent internal friction produced by the dissipative motion of dislocations in alloys has been calculated. The equation of motion describing the dislocation behavior (including inertial and viscous forces) was integrated using a method developed by Labusch and Schwarz. The flow stress and other properties can be derived from the general shape and asymptotic behavior of the decrement vs stress-amplitude curves. When these crystals were annealed, the measurements were better described by the Granato-Lucke theory. The calculations also showed good agreement with measurements in superconducting materials. 40 refs.

6561 Superconductivity

REFER ALSO TO CITATION(S) 31433

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 31357, 31399

31434 **(DOE/ER/03992—400) Constraint dynamics of particle world lines.** Sudarshan, E.C.G.; Mukunda, N.; Goldberg, J.N. (Texas Univ., Austin (USA); Syracuse Univ., NY (USA). Dept. of Physics). Jan 1981. Contract AS05-76ER03992. 51p. NTIS, PC A04/MF A01. Order Number DE81028338.

The Dirac Generator formulation for relativistic Hamiltonian dynamics is extended by explicitly separating the question of dynamical evolution in an inertial frame from that of changes of frame. A new eleven generator formalism is obtained: ten to realize the Poincare Lie algebra, and one to provide equations of motion. For point particle systems, a new form of the world line conditions is developed. It is demonstrated that with these extensions one can consistently describe classical point particles with interaction in a relativistically invariant way while maintaining invariant world lines. This paper uses the approach based on independent particle variables to set up such theories.

31435 **Polarizability of a small sphere including nonlocal effects.** Dasgupta, B.B.; Fuchs, R. (Department of Electrical Engineering, Marquette University, Milwaukee, Wisconsin 53233). W-7405-ENG-82. *Physical Review* [*Section*] *B: Condensed Matter ;* **24**: No. 2, 554-561(15 Jul 1981).

We develop a simple semiclassical method for calculating the polarizability of a very small spherical particle by taking into account the nonlocal nature of the dielectric response. Our theory is very general in the sense that it can be applied to any material which can be characterized by a bulk dielectric function of the form ϵ/sub B/(k,ω): We introduce a new additional boundary condition (ABC) which is similar but not exactly equivalent to the Fuchs-Kliewer ABC. The theory is applied to calculate the polarizabilities of dielectric and metallic spheres.

31436 **Classical behavior of large N fermionic systems.** Kessler, D.A.; Levine, H. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08544). E7-76-C02-3072. *Annals of Physics (New York) ;* **133**: No. 1, 13-27(15 Apr 1981).

The large N limit of several fermionic systems in two dimensions is shown to be obtainable by doing classical mechanics. This

generalizes results previously derived for bosonic models. For these types of theories, the reduction to a classical system of equations is closely related to the path integral quantization scheme of Dashen, Hasslacher and Neveu. Using this relationship, we are able to gain further insight into the workings of both approaches.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 31388, 31402

31437 **(AD-A—091307) On the WKB approximation to the propagator for arbitrary Hamiltonians. Professional paper.** Mizrahi, M.M. (Center for Naval Analyses, Alexandria, VA (USA). Naval Warfare Analysis Group). Aug 1980. 28p. NTIS, PC A03/MF A01.

The purpose of this paper is to obtain a general expression for the WKB approximation to the propagator corresponding to an arbitrary Hamiltonian operator. In an earlier publication, a range of validity of Van Vleck's well-known formula, which was known not to be universally valid was determined. The approximation derived here, generalizing Van Vleck's formula, is also valid beyond quantum-mechanical applications such as the Fokker-Planck equation for diffusion processes. It operates in n dimensions and summation over repeated indices is implied.

31438 **(ANL—81-43) Improving the accuracy of computed eigenvalues and eigenvectors.** Dongarra, J.J.; Moler, C.B.; Wilkinson, J.H. (Argonne National Lab., IL (USA)). Jul 1981. Contract W-31-109-ENG-38. 31p. NTIS, PC A03/MF A01. Order Number DE81028480.

This paper describes a computational method for improving the accuracy of a given eigenvalue and its associated eigenvector. The method is analogous to iterative improvement for the solution of linear systems. An iterative algorithm using working precision arithmetic is applied to increase the accuracy of the eigenpair. The only extended precision computation is the residual calculation. The method is related to inverse iteration and to Newton's method applied to the eigenvalue problem.

31439 **(DOE/ER/70019—T9) Wave propagation through longitudinally and transversally inhomogeneous slabs-I.** Wilcox, R. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). 10 Sep 1970. Contract AT03-76ER70019. 26p. NTIS, PC A03/MF A01. Order Number DE81026100.

The problem of steady-state wave propagation of a scalar wave through a slab which is inhomogeneous in both longitudinal and transverse directions is described by the two-dimensional reduced wave equation. By Fourier transforming the transverse component, the problem is reduced to a two-point boundary-value problem, which in turn is reduced to a Cauchy system (initial-value problem). A technique is given for handling Dirac δ-functions occurring in the Cauchy system which separates out plane-wave and diffractive effects. Integration of the Cauchy system appears to be feasible, and will give results for various slab thicknesses and angles of incidence of the incident wave vector. Reflection and transmission functions are defined which exhibit interesting reciprocity relations between incident and emergent wave vectors.

31440 **Initial value problems for the Carleman equation.** Kaper, H.G.; Leaf, G.K. London, England; Pergamon Press Ltd. (1980). 18p.

The results summarize the current state of knowledge about the initial value problem for the Carleman equation. Basically, the results relate to two different types of problems. The pure initial value problem is considered subject to appropriate constraints on the initial data. In the positive cone of the space of integrable functions the solution is obtained from the initial data via a contraction semigroup. By suitably restricting the range of initial data the semigroup generates a classical solution, the existence of which was established earlier by Kolodner who used fixed point arguments and special properties of solutions of Riccati equations. For constant initial data of the type $u_1(x,0) = u_2(x,0) =$ a for all x an element of R, where a is some positive constant, the Carleman equation admits the solution $u_1(x,t) = u_2(x,t) =$ a for all x an element of $R \geqq 0$, at least within the realm of classical solutions. A small perturbation of the initial data, $u_1(x, 00 =$ a + $phi_1(x), u_2(x,0) =$ a + $phi_2(x)$, x an element of R, say, will lead to a perturbation of this uniform steady state. If the solution is represented in the form $u_1(x,t) =$ a + $eta_1(x,t), u_2(x,t) =$ a + $eta_2(x,t)$, x an element of R, $t \geqq 0$, the perturbations eta_1 and eta_2 are expected to decay to zero as t increases. This, then, is the second type of initial value problem related to the Carleman equation. In the Hilbert space of square integrable functions the perturbations decay algebraically to zero as $t \rightarrow \infty$, provided the initial perturbations (phi_1, phi_2) are sufficiently smooth and sufficiently small.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 31085, 31346, 31499

31441 **(DOE/ER/53050—1) Tokamak research on Versator II. Final report, October 1, 1978-June 30, 1980.** (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). 1980. Contract AS02-78ET53050. 51p. NTIS, PC A04/MF A01. Order Number DE81029031.

The detailed physical processes involved in rf heating of a tokamak plasma were studied during this period. Equilibrium and diagnostic studies are also reported. (MOW)

31442 **(DOE/ER/53117—1) Saturated tearing modes in tokamaks with divertors. Quarterly progress report, April 1-June 30, 1981.** Bateman, G. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). 29 Jun 1981. Contract AS05-81ER53117. 5p. NTIS, PC A02/MF A01. Order Number DE81028457.

A finite aspect ratio self-consistent model for saturated tearing mode magnetic island widths in plane slab and cylindrical geometries was developed. Some effects of bundle divertors and ripple reduction coils are also described. (MOW)

31443 **(DOE/ET/53051—25) Driving force of the ballooning instability.** Phillips, M.W.; Prager, S.C. (Wisconsin Univ., Madison (USA)). Jul 1981. Contract AS02-76ET53051. 9p. NTIS, PC A02/MF A01. Order Number DE81023099.

It is shown that the ballooning mode is (diamagnetic) current driven, not pressure driven. A physical picture and application to experiment is provided.

31444 **Electron cyclotron/upper hybrid resonant pre-ionization in the ISX-B tokamak.** Gilgenbach, R.M. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering); Read, M.E. (Naval Research Lab., Washington, DC (USA)); Hackett, K.E. (Massachusetts Inst. of Tech., Cambridge (USA)). *Nuclear Fusion ;* **21**: No. 3, 319-327(Mar 1981).

Pre-ionization experiments have been performed on a tokamak by injecting about 80 kW of microwave power at 35 GHz for up to 15 ms. Microwave absorption occurs at the electron cyclotron and upper hybrid resonance frequencies as predicted by theory. Pre-ionization causes substantial (40%) reductions in loop voltage during the initial phase of the tokamak shot. Flux (volt-second) savings with pre-ionization are about 30% in the first 2 ms or about 2% of the total flux expenditure in a tokamak shot. The plasma current begins 200 μs earlier and rises 1.4 times more rapidly in the pre-ionized case. Electron densities of $5 \times 10^{12} cm^{-3}$ can be sustained throughout the microwave pulse with only a toroidal magnetic field during microwave injection. The bulk electron temperature in the pre-ionized plasma is about 10 eV although there are indications of higher electron temperatures (50 eV) in the upper hybrid resonance layer. Although questions exist concerning the quiescent behaviour of the pre-ionized plasma, the observed parameters are shown to be consistent with a theory which employs classical models of energy and particle balance. During the early stages of Ohmic heating, the pre-ionization is effective in decreasing the peak of the radiated power.

31445 (GA-A—16387) Neutral-beam-induced alteration in impurity transport: summary of experiments and a possible theoretical explanation. Burrell, K.H. (General Atomic Co., San Diego, CA (USA)). Jul 1981. Contract AT03-76ET51011. 30p. NTIS, PC A03/MF A01. Order Number DE81028506.

Some recent tokamak experiments show that neutral beam injection parallel to the plasma current appears to reduce inward impurity transport while injection anti-parallel enhances it. Concentrations of iron and externally injected argon impurities are higher with counter-injection in ISX-B while tungsten impurity profiles are significantly more peaked in PLT with counter-injection than with co-injection. On the other hand, radial profiles of neon in PLT show little change with direction of injection. Initial theories of beam effects on impurities considered the direct momentum input into the impurities due to Coulomb collisions with fast beam ions. A more recent theory considers the additional effect of beam-induced plasma rotation on impurity transport. Measured rotation speeds in beam-injected PLT discharges show rotation speeds around 100 km/sec, which is quite close to the iron thermal speed in PLT. The theoretical results show outward transport for co-injection when the rotation speeds exceeds the impurity thermal speed.

31446 (PIFR—557-1) Linear system heating by intense relativistic-electron beam. Reporting period, October 1974-June 1975. (Physics International Co., San Leandro, CA (USA)). Jul 1975. Contract AC03-76SF00948. 38p. NTIS, PC A03/MF A01. Order Number DE81024300.

Program emphasis was on the electron-beam heated linear solenoid. Modifications of the experimental apparatus were undertaken in order to fully ionize the plasma before beam injection, allowing operation at the high plasma densities appropriate for linear systems experiments. A computer code was developed for calculating heating from e-i turbulence using quasilinear theory. A new analytic theory of nonlinear excitation of e-i turbulence from e-e modes has been formulated. Finally, analysis of the experiments on beam injection with neutral and weakly preionized hydrogen was completed. (MOW)

31447 (PPPL—1793) Cyclotron emission during electron heating by Landau wave damping of slow modes in tokamak palsmas. Fidone, I.; Granata, G.; Meyer, R.L.; Bernabei, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1981. Contract AC02-76CH03073. 22p. NTIS, PC A02/MF A01. Order Number DE81027712.

The emission of cyclotron radiation from PLT plasma in the presence of a mildly superthermal tail in the electron velocity distribution is investigated. The emitted spectrum has asymmetries which can be used to investigate the tail formation during slow modes electron Landau damping.

31448 (PPPL—1807) Stochasticity, superadiabaticity, and the theory of adiabatic invariants and guiding center motion. Dubin, D.H.E.; Krommes, J.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1981. Contract AC02-76CH03073. 22p. NTIS, PC A02/MF A01. Order Number DE81028794.

The theory of adiabatic invariants is discussed within the modern framework of symplectic Hamiltonian dynamics. The distinctions between exact, adiabatic, and superadiabatic invariants are clarified. The intimate connection between adiabatic (as opposed to exact) invariance and resonant interactions between motions on disparate time scales is elucidated. For the important case of charged particle motion in a strong magnetic field, resonances between gyration, bounce motion, and an external sinusoidal perturbation are described explicitly by introducing a time-dependent symplectic formulation of the guiding center motion. Destruction of invariance is discussed for quite general situations of physical interest, including the case of a trapped particle in a tokamak.

31449 (PPPL—1815) Some aspects of alpha-particle heating. Post, D.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1981. Contract AC02-76CH03073. 33p. NTIS, PC A03/MF A01. Order Number DE81026423.

The heating, detection and measurement, and exhaust of alpha particles in tokamaks is discussed.

31450 (PPPL—1819) Ion Bernstein-wave excitation via finite-Larmor-radius mode-transformation process. Ono, M.; Wong, K.L.; Wurden, G.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1981. Contract AC02-76CH03073. 40p. NTIS, PC A03/MF A01. Order Number DE81028788.

It is shown that in the ion cyclotron range of frequency $\omega \leqq 2\ \Omega/\text{sub i}/$, the finite-Larmor-radius effect removes the wave singularity at the lower-hybrid resonance layer, enabling an externally initiated electron plasma wave to propagate freely through the resonance layer, transforming continuously into an ion Bernstein wave. In an ACT-1 hydrogen plasma (T/sub e/ $\simeq$ 2.5 eV, T/sub i/ $\simeq$ 1.5 eV), linear excitation of ion Bernstein waves has been investigated experimentally for $\omega \simeq 2\Omega/\text{sub i}/$. The mode-transformation process resulting in a strong $\omega \simeq 2\ \Omega/\text{sub i}/$ ion Berstein wave excitation without observable reflections has been experimentally verified. Detailed measurements of wave dispersion relation and of the wave-packet trajectory show excellent agreement with theory.

31451 (PPPL—1822) Enhanced-confinement class of stellarators. Mynick, H.E.; Chu, T.K.; Boozer, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1981. Contract AC02-76CH03073. 14p. NTIS, PC A02/MF A01. Order Number DE81028727.

A class of stellarators has been found in which the transport is reduced by an order of magnitude from transport in conventional stellarators, by localizing the helical ripple to the inside of the torus. The reduction is observed in numerical experiments and explained theoretically.

31452 (PPPL—1823) Stability in straight stellarators. Kulsrud, R.M.; Yoshikawa, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1981. Contract AC02-76CH03073. 23p. NTIS, PC A02/MF A01. Order Number DE81026424.

The stability of the straight stellarator against localized interchange modes is investigated employing the Mercier-Greene-Johnson criterion. Critical values of β are obtained both numerically and analytically. The conclusion is that for classical helical stellarators the average limiting β's are quite low of order three to four percent.

31453 (PPPL—1826) PDX infrared TV camera system. Jacobsen, R.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1981. Contract AC02-76CH03073. 20p. NTIS, PC A02/MF A01. Order Number DE81025936.

An infrared TV camera system has been developed for use on PDX. This system is capable of measuring the temporal and spatial energy deposition on the limiters and divertor neutralizer plates; time resolutions of 1 ms are achievable. The system has been used to measure the energy deposition on the PDX neutralizer plates and the temperature jump of limiter surfaces during a pulse. The energy scrapeoff layer is found to have characteristic dimensions of the order of a cm. The measurement of profiles is very sensitive to variations in the thermal emissivity of the surfaces.

31454 Tandem mirror confinement in the presence of ion cyclotron fluctuations. Rognlien, T.D.; Matsuda, Y. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Nuclear Fusion ;* **21**: No. 3, 345-358(Mar 1981).

A theoretical model is developed for the effect of an electrostatic ion-cyclotron wave on central-cell ion confinement in a tandem mirror. Ion heating occurs in the central cell where the wave and local ion-cyclotron frequencies are equal. Coulomb pitch-angle collisions then scatter these ions into the loss region of velocity space. The wave heating is calculated analytically from the single-particle equations of motion, and the effect of collisions is modelled numerically by using a Monte-Carlo technique. A formula is obtained for the degradation of the ion-confinement time as a function of the rf wave amplitude. This formula reproduces the experimental results from the Livermore Tandem Mirror Experiment (TMX) as they are presented in a companion paper. The effect of the wave on density and temperature profiles is also calculated.

31455 **(UCID—19159) Barrier-potential model.** Pearlstein, L.D.; Nevins, W.M. (Lawrence Livermore National Lab., CA (USA)). 4 Aug 1981. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01. Order Number DE81028243.

A useful model for calculating the variation in the electron density, ion density, and ambipolar potential along magnetic field lines in the thermal barrier cell of a tandem mirror is presented.

31456 **Decay instability of a whistler in a plasma.** Tewari, D.P.; Sharma, R.R. (Department of Physics, Indian Institute of Technology, New Delhi 110016, India). *Journal of Applied Physics ;* **52**: No. 8, 5007-5009(Aug 1981).

The parametric instabilities of a high power whistler in a high-density plasma possess large growth rates when the scattered sideband is an electrostatic lower hybrid mode. The efficient channels of decay include oscillating two stream instability, nonlinear Landau damping, and resonant decay involving ion acoustic and ion cyclotron modes. The processes of nonlinear scattering i.e., the ones possessing whistler sidebands are relatively less significant.

31457 **Anomalous transport due to shear Alfven waves.** Lee, W.W.; Chance, M.S.; Okuda, H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CH03073. *Physical Review Letters ;* **46**: No. 26, 1675-1678(29 Jun 1981).

The behavior of shear Alfven eigenmodes and the accompanied anomalous transport have been investigated. In the particle simulation, equilibrium thermal fluctuations associated with the eigenmodes have been observed to nullify the zeroth-order shear near the rational surface through the induced second-order eddy current, and, in turn, give rise to the formation of magnetic islands which cause rapid electron energy transport in the region. The theoretical verification of the observed behavior is discussed.

31458 **Second region of stability against ballooning modes.** Greene, J.M.; Chance, M.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion ;* **21**: No. 4, 453-464(Apr 1981).

A new type of axisymmetric magnetohydrodynamic equilibrium is presented. It is characterized by a region of pressure and safety factor variation with a short scale length imposed as a perturbation. The equilibrium consistent with these profile variations can be calculated by means of an asymptotic expansion. The flexibility obtained by generating such equilibria allows for a close examination of the mechanisms that are relevant to ballooning instabilities - ideal-MHD modes with large toroidal mode number. The so-called first and second regions of stability against these modes are seen well within the limits of validity of the asymptotic expansion. It appears that the modes must be localized in regions with small values of the local shear of the magnetic field. The second region of stability occurs where the local shear is large throughout the range where the magnetic-field-line curvature is destabilizing.

31459 **MHD tilting modes for nearly spherical compact toroids with arbitrary plasma pressure.** Hammer, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Nuclear Fusion ;* **21**: No. 4, 488-492(Apr 1981).

The ideal-MHD analysis of tilting is extended to arbitrary plasma pressure and configuration with the limitation that the separatrix and wall remain nearly spherical. An expansion about the lowest-order eigenmode, a rigid rotation, is used to reduce deltaW to surface integrals involving only known equilibrium quantities. Previous results are recovered, showing that elliptically prolate structures are unstable for a wall outside the separatrix and elliptically oblate structures are stable with a conducting shell close but outside the separatrix. New results include: non-elliptical prolate shapes can be stable (problimaks); a wall inside the separatrix is stabilizing; stability is insensitive to the magnitude of the plasma pressure but somewhat sensitive to the current profile; at fixed wall-surface area, factors of two in the stability conditions are achieved by changing the separatrix and wall shapes.

31460 **N-dependence of ballooning instabilities.** Dewar, R.L.; Manickam, J.; Grimm, R.C.; Chance, M.S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion ;* **21**: No. 4, 493-498(Apr 1981).

The critical β for stability against ideal hydromagnetic internal ballooning modes as a function of the toroidal mode number, n, is calculated for two different equilibrium sequences by use of a finite-element technique (n approximately <20), and a WKB formalism (n approximately >5). The agreement between the two methods is good in the overlap region 5 approximately $<$n approximately <20. The WKB formula reduces to the '1/n correction' at very high n, but is much more accurate at moderate n. The critical-β-versus-n curves exhibit oscillatory structure at low n, but in both sequences the lower bound on βsub(c) is set by n=infinite modes at about βsub(c) approximately 5%.

31461 **Stability of the field-reversed mirror.** Morse, E.C.; Miley, G.H. (Illinois Univ., Urbana (USA); California Univ., Berkeley (USA). Dept. of Nuclear Engineering). *Nuclear Fusion ;* **21**: No. 4, 473-479(Apr 1981).

The stability of a field-reversed mirror plasma configuration is studied with an energy principle derived from the Vlasov equation. Because of finite orbit effects, the stability properties of a field-reversed mirror are different from the stability properties of similar magnetohydrodynamic equilibria. The Vlasov energy principle developed here is applied to a computer simulation of an axisymmetric field-reversed mirror state. Possible instabilities with l=1,2 are found at low growth rate. A simple physical model for this instability is outlined.

31462 **Effect of end-cell stability on the confinement of the central-cell plasma in TMX.** Drake, R.P.; Casper, T.A.; Clauser, J.F (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Nuclear Fusion ;* **21**: No. 3, 359-364(Mar 1981).

In the Tandem Mirror Experiment (TMX), the central-cell losses provide the warm unconfined plasma necessary to stabilize the drift-cyclotron loss-cone instability in the end cells. This places a theoretical limit on central-cell confinement, which is expressed as a limit on the end-cell to central-cell density ratio. As this density ratio increases in a TMX experiment, large increases of end-cell ion-cyclotron-frequency plasma fluctuations are observed. These fluctuations cause the central-cell confinement to decrease, in agreement with a theoretical model.

31463 **Neoclassical current effects in neutral-beam-heated tokamak discharges.** Hogan, J.T. (Oak Ridge National Lab., TN (USA)). *Nuclear Fusion ;* **21**: No. 3, 365-387(Mar 1981).

There is a long-standing prediction from neoclassical theory that strong contributions to the toroidal current should be driven by friction between trapped and passing particles when β/sub pol/ exceeds root (R/a) in a tokamak. A number of neutral-beam heating experiments can now produce such parameters, and it is of interest to calculate the behavior which should occur in this regime to determine the feasibility of using such a bootstrap current as a steady-state tokamak current source. It is found that the neoclassical current should be large enough to reverse the external loop voltage for typical experimental parameters (ISX-B, in particular) in cases where the total current is fixed and to produce a detectable excess of total current above the pre-programmed (demand) value in cases where the loop voltage is regulated. Other manifestations of such a current should be either: a sharp rise in the central q-value (producing a cessation of internal m = 1 and M = 2 MHD activity), with an enhancement by two orders of magnitude of ion thermal conductivity (due to the formation of a hollow current density profile and a consequent drop in local values of the poloidal magnetic field in the central plasma region), or an enhanced tendency for disruption (arising from magnetic reconnection in hollow-profile equilibria). Since these gross manifestations are absent in a wide range of experiments on the Impurity Study Experiment (ISX-B), as reported earlier, the conclusion is that the neoclassical current, if present, can have a value no larger than 25% of its theoretically calculated value. Since the neoclassical particle (Ware) pinch is strongly related to the neoclassical current in the theory (Onsager reciprocity), the existence of the particle pinch is thus called into question.

31464 **Physics of DT ignition in small fusion targets.** Kirkpatrick, R.C. (Los Alamos Scientific Lab., NM (USA)); Wheeler, J.A. (Texas Univ., Austin (USA)). *Nuclear Fusion ;* **21**: No. 3, 389-401(Mar 1981).

Ignition of sub-milligram fusion targets is critically dependent on DT temperature, density, radius, radiation temperature, implosion velocity, and other parameters that characterize the target and its implosion. This paper discusses the interplay of such major physical processes as bremsstrahlung, Compton scattering, DT fusion, hydrodynamics, and thermal conduction during the implosion and especially near turn-around where the potential for ignition or failure most critically depends on the small differences between large rates of energy loss and gain. The phase plane analysis presented here proves to be most advantageous in understanding the DT ignition problem. Four examples are discussed in order to illustrate the interplay of the various physical processes.

31465 Ballooning-mode theory of trapped-electron instabilities in tokamaks. Cheng, C.Z.; Chen, L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion ;* **21**: No. 3, 403-408(Mar 1981).

Employing the ballooning-mode formalism, the two-dimensional eigenmode equation for trapped-electron instabilities in tokamaks is reduced to a one-dimensional integro-differential equation along the magnetic field lines and then analysed both analytically and numerically. Dominant toroidal coupling effects are due to ion magnetic drifts which create quasi-bound states. The trapped-electron response can be treated as a perturbation and is found to destabilize the quasi-bound states.

31466 Significance of magnetic shielding in the ablation of a solid hydrogen pellet in a plasma. Gilliard, R.P.; Kim, K. (GE, Cleveland, Ohio). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science ;* **PS-8**: No. 4, 477-484(Dec 1980).

A one dimensional model is presented of the time-dependent magnetic field configuration in the vicinity of an ablating pellet in the plasma. This information is first used to determine the reduction in the incident energy flux to the ablation cloud compared with the case where there is not bending of field lines. A self-consistent model of pellet ablation is then constructed where the magnetic field exclusion (rarefaction) is considered to be a quasi-steady state process. Finally, the time-dependent aspects of the problem are considered, and conclusions are drawn concerning the extent to which the magnetic shielding effects can be expected to be important in the ablation cloud dynamics in thermonuclear tokamaks. 17 refs.

31467 Prospects for heating tokamaks by parametric decay of intense extraordinary mode radiation. Elder, G.B.; Perkins, F.W. Jr. (Princeton Plasma Phys Lab, NJ). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science ;* **PS-8**: No. 4, 494-502(Dec 1980).

A wave equation governing the propagation of extraordinary mode radiation in a nonuniform plasma is derived, and it is solved to provide a quantitative description of its intensity and spatial variation. The frequencies and wave vectors that will maximize A, the measure of the energy transferred from the extraordinary wave to the plasma, are then found, and these results are used to predict the necessary power of A's of six. 10 refs.

31468 Fokker-Planck/transport studies of the Tokamak Fusion Test Reactor. Mirin, A.A.; Jassby, D.L. (Lawrence Livermore Lab, Calif). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science ;* **PS-8**: No. 4, 503-511(Dec 1980).

The performance is investigated of beam-heated DT plasmas in the Tokamak Fusion Test Reactor for two generic modes of operation: mode I, with deuterium beam injection and tritium gas injection, and with a high wall recycling coefficient; mode II, with both deuterium and tritium beam injection, but with no gas or pellet injection, and with a low wall recycling coefficient. The time-dependent behavior of these plasmas has been analyzed with a numerical one-dimensional transport model, coupled with nonlinear Fokker-Planck analysis of the injected energetic ions. 23 refs.

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REFER ALSO TO CITATION(S) 30069, 30621, 30914, 30916, 30917, 30980, 31442, 31451, 31464, 31466

31469 (ANL/FPP/TM—145) Argonne Plasma Engineering Experiment (APEX) Tokamak. Norem, J.H.; Balka, L.J.; Kulovitz, E.E.; Magill, S.R.; McGhee, D.G.; Moretti, A.; Praeg, W.F. (Argonne National Lab., IL (USA)). Mar 1981. Contract W-31-109-ENG-38. 45p. NTIS, PC A03/MF A01. Order Number DE81028479.

The Argonne Plasma Engineering Experiment (APEX) Tokamak was designed to provide hot plasmas for reactor-relevant experiments with rf heating (current drive) and plasma wall experiments, principally in-situ low-Z wall coating and maintenance. The device, sized to produce energetic plasmas at minimum cost, is small (R = 51 cm, r = 15 cm) but capable of high currents (100 kA) and long pulse durations (100 ms). A design using an iron central core with no return legs, pure tension tapewound toroidal field coils, digital radial position control, and UHV vacuum technology was used. Diagnostics include monochrometers, x-ray detectors, and a microwave interferometer and radiometer for density and temperature measurements. Stable 100 ms shots were produced with electron temperatures in the range 500 to 1000 eV. Initial results included studies of thermal desorption and recoating of wall materials.

31470 (DOE/DP/70104—T1) Research studies on short optical pulse generation for the laser fusion program. Final report, 11 January 1976-11 March 1977. Kuizenga, D.J. (Stanford Research Inst., Menlo Park, CA (USA)). 30 Mar 1977. Contract AT03-76DP70104. 22p. NTIS, PC A02/MF A01.

The development of a simultaneously mode-locked and Q-switched Nd:YAG laser is reported. (MOW)

31471 (DOE/ET/52049—T1) Georgia Institute of Technology fusion research program. Final progress report, FY 1981. Stacey, W.M. Jr. (Georgia Inst. of Tech., Atlanta (USA)). Apr 1981. Contract AS05-79ET52049. 6p. NTIS, PC A02/MF A01. Order Number DE81028655.

A summary of work performed, a listing of persons involved, and a list of publications in which the work is described in detail are included. (MOW)

31472 (DOE/ET/53061—T1) Study of the high-density high-energy plasma-producing methods and physical-property measurements and its application for thermonuclear reaction. Final report, February 1, 1979-December 31, 1979. (Santa Clara Univ., CA (USA). School of Engineering). 29 Apr 1980. Contract AS03-76ET53061. 72p. NTIS, PC A04/MF A01. Order Number DE81026186.

During this recently concluded contract period, the primary work emphasis was shifted to the cooperative programs with other laboratories on the deflagration gun plasma injection work. The degree of help provided from this lab to other laboratories has varied from providing the gun, the associated capacitor banks and controls, along with actually running the experiment, to making new gun valve assemblies and new capacitor banks, to loaning deflagration guns and power supplies, to providing blueprints of the gun and transferring know-how, to modifying existing guns for operation in the deflagration mode. The experimental results are described in detail.

31473 (GA-A—16272) Data management in a fusion energy research experiment. Glad, A.; Drobnis, D.; McHarg, B. (General Atomic Co., San Diego, CA (USA)). Jul 1981. Contract AT03-76ET51011. 33p. NTIS, PC A03/MF A01. Order Number DE81027932.

Present-day fusion research requires extensive support for the large amount of scientific data generated, bringing about three distinct problems computer systems must solve: (1) the processing of large amounts of data in very small time frames; (2) the archiving, analyzing and managing of the entire data output for the project's lifetime; (3) the standardization of data for the exchange of

information between laboratories. The computer system supporting General Atomic's Doublet III tokamak, a project funded by the United States Department of Energy, is the first to encounter and address these problems through a system-wide data base structure.

31474 **(GA-A—16422) Superfluid helium bath cooling of a tokamak reactor toroidal field coil system.** Hsu, Y.H.; Purcell, J.; Alcorn, J. (General Atomic Co., San Diego, CA (USA)). Jul 1981. Contract AT03-76ET51011. 10p. NTIS, PC A02/MF A01. Order Number DE81028341.

A conceptual design of a FED reactor compatible toroidal field (TF) coil system employing NbTi alloy conductor and superfluid helium bath cooling is discussed. In order to achieve 11 tesla, NbTi alloy conductor must operate at a temperature below 4.2 K. After a year of comparative analytical and experimental studies, General Atomic has concluded that He II (superfluid) operation may be preferable to subatmospheric, subcooled He I conditions. Some of the features of this system are described.

31475 **(GA-A—16430) Process evaluation and characterization of TiC coating on graphite for Doublet III limiters and neutral beam armor.** Trester, P.W.; Sevier, D.L.; Chin, J.; Horner, M.H.; Staley, H.G.; Kaplan, R. (General Atomic Co., San Diego, CA (USA)). Aug 1981. Contract AT03-76ET51011. 6p. (CONF-810831—18). NTIS, PC A02/MF A01. Order Number DE81029070.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

An investigation was conducted to evaluate a thin coating of TiC deposited on a graphite substrate by a commercial CVD coating process. Microstructural analyses are presented for specimens positioned at various locations within the retort during the CVD coating runs. Coating requirements for thickness, quality and uniformity were met. These findings provide the data base for production coating graphite neutral-beam armor and limiter tiles for Tokamaks.

31476 **(HEDL—6838) Nuclear data for damage studies and FMIT (WHO25/EDK).** Johnson, D.L.; mann, F.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1980. Contract AC14-76FF02170. 11p. NTIS, PC A02/MF A01. Order Number DE81026510.

Neutron spectra and radiation heating data have been obtained from preliminary analysis of measurements of the transmission of FMIT-like neutrons through thick iron. These data will be used to confirm neutron transport calculations used for predictions of radiation heating in FMIT test cell walls but will also shed light on neutron transport calculations within an experimental test matrix. Analysis of measurements of the prompt gamma yield and spectra from the thick target Li(d,xγ) reaction at 35 MeV shows a very small gamma yield of low energy gamma rays. Hence this contribution to radiation heating and damage is expected to be much smaller than neutron contributions.

31477 **(HEDL—6935) Spectral effects experiments.** Panayotou, N.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract AC14-76FF02170. 21p. NTIS, PC A02/MF A01. Order Number DE81027815.

The objective of this work is to determine the effects of high energy neutrons on damage production and evolution, and the relationships of these effects to effects produced by fission reactor neutrons. The test facilities and some preliminary measurements are described. (MOW)

31478 **Options for light-ion fusion.** Humphries, S. Jr. (Sandia Labs., Albuquerque, NM (USA)). *Comments on Plasma Physics and Controlled Fusion ;* **6**: No. 1, 45-52(Sep 1980).

With the development of new methods of ion injection and the understanding of multistage acceleration and transport of beams, the production of intense beams of ions with mass greater than that of the proton can be considered for the light-ion inertial-confinement fusion approach. It is shown that advantages would be associated with the use of ions such as O^+ in the range of 50 MeV. For this case, the demonstration of a beam module with power flux appropriate for fusion would not involve great extrapolations beyond present experience.

31479 **(LA-UR—81-1293) CVD techniques applied to energy problems.** McCreary, W.J.; Carroll, D.W. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 15p. (CONF-810907—1). NTIS, PC A02/MF A01.

From 8. international conference on chemical vapor deposition; Gouvieux, France (15 Sep 1981).

Some of the applications of chemical vapor deposition in energy related programs will be discussed, and coating parameters will be described. The coatings to be discussed were made at reduced pressures from the hydrogen reduction of metal fluorides, or metal silane and from the pyrolysis of metal carbonyls.

31480 **(LA-UR—81-2140) In situ mechanical-radiation effects test capsule for simulating fusion material environments.** Christensen, K.E.; Bennett, G.A.; Sommer, W.F. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 5p. (CONF-810831—7). NTIS, PC A02/MF A01. Order Number DE81028773.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Conditions of radiation and simultaneous cyclic stress on materials are inherent in advanced energy source designs such as inertially and magnetically confined controlled thermonuclear reactors. A test capsule capable of applying a cyclic stress to test specimens while they are being irradiated in the 800-MeV proton beam at the Clinton P. Anderson Los Alamos Meson Physics Facility has been developed. The design and performance of this device are discussed in this report. This machine has facilities for seven pairs of differential samples; one sample of a pair receives an applied cyclic stress and its companion in an identical flux will be the unstressed control. Control of the sample temperature and in situ monitoring of sample elongation and load are provided in the design. Results of an earlier experiment will be discussed, along with those of preliminary bench tests of the redesigned capsule.

31481 **(LA-UR—81-2141) Enhanced energy deposition symmetry by hot electron transport.** Wilson, D.; Mack, J.; Stover, E.; VanHulsteyn, D.; McCall, G.; Hauer, A. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 16p. (CONF-810576—2). NTIS, PC A02/MF A01. Order Number DE81028774.

From Topical conference on symmetry aspects of inertial fusion implosions; Washington, DC, USA (27 May 1981).

High energy electrons produced by resonance absorption carry the CO_2 laser energy absorbed in a laser fusion pellet. The symmetrization that can be achieved by lateral transport of the hot electrons as they deposit their energy is discussed. A K/sub α/ experiment shows a surprising symmetrization of energy deposition achieved by adding a thin layer of plastic to a copper sphere. Efforts to numerically model this effect are described. (MOW)

31482 **(LA-UR—81-2161) Displacement cascades in diatomic materials.** Parkin, D.M.; Coulter, C.A. (Los Alamos National Lab., NM (USA); Alabama Univ., University (USA)). 1981. Contract W-7405-ENG-36. 5p. (CONF-810831—8). NTIS, PC A02/MF A01. Order Number DE81028777.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

A new function, the specified-projectile displacement function p/sub ijk/ (E), is introduced to describe displacement cascades in polyatomic materials. This function describes the specific collision events that produce displacements and hence adds new information not previously available. Calculations of p/sub ijk/ (E) for MgO, Al_2O_3 and TaO are presented and discussed. Results show that the parameters that have the largest effect on displacement collision events are the PKA energy and the mass ratio of the atom types in the material. It is further shown that the microscopic nature of the displacement events changes over the entire recoil energy range relevant to fusion neutron spectra and that these changes are different in materials whose mass ratio is near one than in those where it is far from one.

31483 **(LA-UR—81-2192) Simplified extension of the LSI-11 Q-Bus for a high energy laser control application.** Burczyk, L. (Los Alamos National Lab., NM (USA); Nelson and Johnson Engineering, Boulder, CO (USA)). 1981. Contract W-7405-ENG-36. 7p. (CONF-810623—12). NTIS, PC A02/MF A01. Order Number DE81027001.

From 24. midwest symposium on circuits and systems; Albuquerque, NM, USA (29 Jun 1981).

Antares, a large, experimental laser fusion facility under construction at Los Alamos National Laboratory in New Mexico, is controlled by a network of PDP-11 minicomputers and microprocessors. The remote nodes of the Antares control network are based on an LSI-11/2 microcomputer interfaced to an STD Bus. This machine interface or MI forms the intelligent process controller located directly adjacent to the many diverse laser subsystem devices. The STD Bus, linked to the LSI-11/2 microcomputer, offers a standardized, cost effective means for the development of the specialized interface functions required for the high energy laser environment.

31484 **(LA-UR—81-2193) Fiber optic analog and timing monitoring system for the antares laser fusion program.** Longmire, J.L.; Thuot, M.E. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 5p. (CONF-810810—12). NTIS, PC A02/MF A01. Order Number DE81028799.

From SPIE international symposium; San Diego, CA, USA (24 Aug 1981).

The development and use of two optical fiber systems for the Antares 40 kJ CO_2 laser is described. In the Antares power amplifier, electron guns produce a discharge-sustaining B kA beam of 500 kV electrons. Eight 300 kJ, 3 μs Marx pulsers provide a direct electrical pumping discharge through the laser gas. The electro-optic systems developed allow the measurement of pulsed analog waveforms and trigger timing information within the laser and power systems by a computer based control and data acquisition network.

31485 **(LA-UR—81-2204) Calorimetry at 10.6 μm using organic volume absorbers.** Sollid, J.E.; Bjork, C.W. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 9p. (CONF-810429—37). NTIS, PC A02/MF A01. Order Number DE81028739.

From Conference on optics; Santa Fe, NM, USA (6 Apr 1981).

Copper-Kapton laminate foils will be utilized as isoperibol calorimeters for pulsed energy measurements at Antares with apertures up to 1.5 m. These are volume absorbing calorimeters in which the radiation is absorbed in a layer tens of wavelengths thick, thereby reducing surface temperature and increasing damage threshold as compared to surface absorbing calorimeters. Kapton was chosen for its high absorption coefficient, 330 cm^{-1} at P(20) in the 10 μm band of CO_2, and its useful short pulse damage threshold, 2.8 J/cm^2. The copper backing integrates the absorbed heat pulse. The resultant temperature pulse is sensed by Type E thermocouples (chromel-constantan) soldered to the copper. Time vs voltage traces of the thermocouples can then be analyzed to obtain the energy absorbed. Calorimeters can be fabricated to virtually any size or shape, using photo-lithographic techniques. Utilizing single elements or several in a thermopile further expands the versatility of this technique.

31486 **(LA-UR—81-2263) Rayleigh-Taylor stability for a shock wave-density discontinuity interaction.** Fraley, G.S. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 32p. (CONF-810576—3). NTIS, PC A03/MF A01. Order Number DE81028707.

From Topical conference on symmetry aspects of inertial fusion implosions; Washington, DC, USA (27 May 1981).

Shells in inertial fusion targets are typically accelerated and decelerated by two or three shocks followed by continuous acceleration. The analytic solution for perturbation growth of a shock wave striking a density discontinuity in an inviscid fluid is investigated. The Laplace transform of the solution results in a functional equation, which has a simple solution for weak shock waves. The solution for strong shock waves may be given by a power series. It is assumed that the equation of state is given by a gamma law. The four independent parameters of the solution are the gamma values on each side of the material interface, the density ratio at the interface, and the shock strength. The asymptotic behavior (for large distances and times) of the perturbation velocity is given. For strong shocks the decay of the perturbation away from the interface is much weaker than the exponential decay of an incompressible fluid. The asymptotic value is given by a constant term and a number of slowly decaying discreet frequencies. The number of frequencies is roughly proportional to the logarithm of the density discontinuity divided by that of the shock strength. The asymptotic velocity at the interface is tabulated for representative values of the independent parameters. For weak shocks the solution is compared with results for an incompressible fluid. The range of density ratios with possible zero asymptotic velocities is given.

31487 **(PPPL—1824) Cool, high-density regime for poloidal divertors.** Petravic, M.; Post, D.; Heifetz, D.; Schmidt, J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1981. Contract AC02-76CH03073. 14p. NTIS, PC A02/MF A01. Order Number DE81028796.

Calculations have been performed which demonstrate the possibility of operating poloidal divertors at high densities and low temperatures. This operating regime is caused primarily by ionization of recycling neutral gas near the divertor neutralizer plate which amplifies the input particle flux thereby raising the plasma density and lowering the plasma temperature. Low temperature, high density operation of poloidal divertors would ease the design requirements for future large tokamaks such as INTOR or FED by reducing the erosion rate in the divertor and reducing the neutral density and the associated charge exchange erosion near the main plasma. This regime may have already been observed on several divertor and limiter experiments.

31488 **(PPPL—1825) Preliminary particle scoop limiter measurements in PDX.** Jacobsen, R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1981. Contract AC02-76CH03073. 14p. NTIS, PC A02/MF A01. Order Number DE81028795.

A plasma edge particle scoop limiter has been installed on the equator of the Princeton Divertor Experiment (PDX), a large tokamak. The scoop limiter is unique in that it is designed such that the plasma plugs the entrance throat thereby impeding the return flow of neutralized gas to the discharge. Neutral gas pressures of the order of 50 microns were measured inside the scoop. The pressure dependence on electron density in the scrapeoff plasma at the throat entrance was stronger than linear.

31489 **(PPPL—1827) Low-aspect-ratio torsatron for high-beta toroidal confinement.** Sheffield, G.V.; Furth, H.P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1981. Contract AC02-76CH03073. 15p. NTIS, PC A02/MF A01. Order Number DE81025883.

A new type of torsatron configuration is characterized by: (1) flux-surface symmetry compatible with high-beta optimization of a tokamak-torsatron hybrid, and (2) unentangled coil topology.

31490 **(SAND—81-0958) Laser research and applications. Semiannual report, October 1980-March 1981.** (Sandia National Labs., Albuquerque, NM (USA)). Jun 1981. Contract AC04-76DP00789. 44p. NTIS, PC A03/MF A01. Order Number DE81026456.

Research progress during this period is given for each of the following topics: (1) rare-gas halogen laser program; (2) laser-triggered switches; (3) laser-controlled ionization front accelerator; (4) lasers for combustion research; (5) 10-μm interferometer for electron density measurements; (6) Q-switched and free-running stable pulse 1.06 μm laser; (7) Raman spectroscopy; (8) multiphoton ionization; (9) chemical vapor deposition and plasma etching; (10) laser-desorption mass spectrometry; (11) collision broadening and shift of the K 4p-ns and 4p-nd lines by Ar, (12) chemically pumped iodine laser; (13) laser-induced chemical reactions; (14) photolytic pumping of a laser by a moving, hot plasma; (15) laser-based surface spectroscopy; (16) laser-generated low-density channels; (17) radiation-driven density waves in optically pumped gas lasers; (18) propagation of an annular laser beam; (19) theoretical modeling of the chemical vapor deposition process; (20) charge exchange cross

sections for C^{6+}-H collisions; (21) the stopping power of gold ions for protons; (22) electron ionization cross sections of low-Z ions; (23) electron shielding effects on fusion cross sections and (24) radiation efficiencies from imploding liners. (MOW)

31491 (UCID—19085) Solution of single linear tridiagonal systems and vectorization of the ICCG algorithm on the Cray 1. Kershaw, D.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jun 1981. 31p. NTIS, PC A03/MF A01. Order Number DE81025461.

The numerical algorithms used to solve the physics equation in codes which model laser fusion are examined, it is found that a large number of subroutines require the solution of tridiagonal linear systems of equations. One dimensional radiation transport, thermal and suprathermal electron transport, ion thermal conduction, charged particle and neutron transport, all require the solution of tridiagonal systems of equations. The standard algorithm that has been used in the past on CDC 7600's will not vectorize and so cannot take advantage of the large speed increases possible on the Cray-1 through vectorization. There is however, an alternate algorithm for solving tridiagonal systems, called cyclic reduction, which allows for vectorization, and which is optimal for the Cray-1. Software based on this algorithm is now being used in LASNEX to solve tridiagonal linear systems in the subroutines mentioned above. The new algorithm runs as much as five times faster than the standard algorithm on the Cray-1. The ICCG method is being used to solve the diffusion equation with a nine-point coupling scheme on the CDC 7600. In going from the CDC 7600 to the Cray-1, a large part of the algorithm consists of solving tridiagonal linear systems on each L line of the Lagrangian mesh in a manner which is not vectorizable. An alternate ICCG algorithm for the Cray-1 was developed which utilizes a block form of the cyclic reduction algorithm. This new algorithm allows full vectorization and runs as much as five times faster than the old algorithm on the Cray-1. It is now being used in Cray LASNEX to solve the two-dimensional diffusion equation in all the physics subroutines mentioned above.

31492 (UCID—19086) Beam propagation in the frequency-converted subsystems of Nova and Novette. Hunt, J.; Simmons, W.; Speck, R.; Warren, W.; Eimerl, D. (Lawrence Livermore National Lab., CA (USA)). 7 Jul 1981. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01. Order Number DE81028253.

An analysis of beam propagation for the frequency converted Nova/Novette systems is given and self-focusing effects are reviewed. It is shown that the nonlinear growth of beam modulation produced by self-focusing is proportional 1/2 exp B where B is the intensity dependent phase retardation (measured in radians) accumulated by the beam. This exponential growth of beam modulation in the baseline frequency conversion/focusing optical train limits the system performance for short pulse (tau $<$ 2 ns), one third micron operation. One micron and one-half micron performance are limited more by the one micron drive available to frequency conversion KDP array than self-focusing.

31493 (UCRL—85137) Inertial fusion and energy production. Holzrichter, J.F. (Lawrence Livermore National Lab., CA (USA)). 13 Nov 1980. Contract W-7405-ENG-48. 39p. (CONF-8011100—1). NTIS, PC A03/MF A01. Order Number DE81026590.

From International scientific forum on geopolitics of energy; Ft Lauderdale, FL, USA (13 Nov 1980).

Portions of document are illegible.

The basic aspects of laser fusion are described. The present status of laser fusion is reviewed. (MOW)

31494 (UCRL—85580) MFTF magnet cryogenics. VanSant, J.H. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 9p. (CONF-810835—1). NTIS, PC A02/MF A01. Order Number DE81027491.

From 1981 cryogenic engineering conference; San Diego, CA, USA (10 Aug 1981).

The prime requirement of the cryogenics of the magnets is to assure a superconducting state for the magnet coils, a large task considering their enormous size. The following presentation addresses the principal topics that have been considered in this cryogenic design.

31495 (UCRL—86087) Applications of intelligent-measurement systems in controlled-fusion research. Owen, E.W.; Shimer, D.W.; Lindquist, W.B.; Peterson, R.L.; Wyman, R.H. (Lawrence Livermore National Lab., CA (USA)). 22 Jun 1981. Contract W-7405-ENG-48. 30p. (CONF-810929—1). NTIS, PC A03/MF A01. Order Number DE81026598.

From International measurement confederation conference; Dubrovnik, Yugoslavia (28 Sep 1981).

The paper describes the control and instrumentation for the Mirror Fusion Test Facility at the Lawrence Livermore National Laboratory, California, USA. This large-scale scientific experiment in controlled thermonuclear fusion, which is currently being expanded, originally had 3000 devices to control and 7000 sensors to monitor. A hierarchical computer control system, is used with nine minicomputers forming the supervisory system. There are approximately 55 local control and instrumentation microcomputers. In addition, each device has its own monitoring equipment, which in some cases consists of a small computer. After describing the overall system a more detailed account is given of the control and instrumentation for two large superconducting magnets.

31496 (WFPS-TMS—80-012) Conceptual design of a commercial tokamak hybrid reactor (CTHR). Final report. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Dec 1980. Contract AC02-77ET52043. 286p. NTIS, PC A13/MF A01. Order Number DE81028375.

This design was developed as a first generation commercial plant for the production of fissile fuel to support a significant number of client Light Water Reactor (LWR) plants. The study has been carried out in sufficient depth to indicate no insurmountable technical problems exist, assuming the physics of the fusion driver is verified, and has provided a basis for deriving cost estimates of the hybrid plant as well as estimates of the hybrid/LWR symbiotic system busbar electricity costs. This energy system has the potential to be optimized such that the net cost of electricity becomes competitive with conventional LWR plants as the price of U_3O_8 exceeds $100 per pound.

31497 Investigation of shell stability in imploding cylindrical targets. Sweeney, M.A.; Perry, F.C. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics ;* **52**: No. 7, 4487-4502(Jul 1981).

As part of a program to determine the feasibility of inertial confinement fusion (ICF), the physics of implosion stability is being studied. Ablatively-driven double-shell cylinders with and without initial periodic perturbations on the outer edge of the pusher were imploded using a single electron beam. Four-pulse holographic shadowgraphy yielded spatially and temporally resolved images of the implosions. The experiments are in a regime where fluidlike behavior is expected to dominate. A comparison of experimental data on the free-surface motion with two-dimensional, planar-geometry numerical calculations which include materials effects indicates shock-accelerated unstable growth of fabrication irregularities at the perturbed material interface. Peak pressures of 0.26 TPa (2.6 Mbars) are inferred in the high-density pusher material. Both the experiment and the calculation show a decrease in the amplitude of the free-surface perturbations at late time. In the experiment this decrease in amplitude begins earlier and the amount of the decrease is larger because of the enhanced interaction of adjacent perturbations due to convergence. The complex nonlinear development of both intentional and nonintentional target perturbations are demonstrated in the experiments.

31498 Start-up of the reversed-field pinch in an adiabatic manner. Carmana, E.J. (Los Alamos Scientific Lab., NM (USA)). *Nuclear Fusion ;* **21**: No. 3, 408-412(Mar 1981).

The equations describing the purely adiabatic formation of the reversed-field pinch are solved. This method of formation, in principle, remedies the problem of flux consumption during the start-up phase of this device. Also discussed is the effect of resistivity on this ideal model.

31499 Nonlinear plasma dynamics at high intensity laser interaction. Miley, G.H.; Hora, H. (Univ of Ill, Urbana). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science ;* **PS-8**: No. 4, 468-476(Dec 1980).

Some aspects of progress in laser fusion are briefly reviewed which indicate that experiments are on the threshold of entering a regime where nonlinear dynamics will become important. Recent studies of the general nonlinear force that include additional nonponderomotive terms are reviewed. Computer calculations that provide a detailed knowledge of the transfer of optical energy into a plasma corona by nonlinear forces are then described. Two key regimes are observed: 1) early production of fast moving cold blocks of plasma followed by 2) a decay of the corona where the plasma velocity obeys a Kortweg-de-Vries equation. 54 refs.

31500 Detection of a normal zone in inductively coupled superconducting coils. Owen, E.W. (Univ of Calif, Davis). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-16**: No. 5, 1289-1294(Sep 1980).

A method is described for the electrical detection of a normal zone in inductively coupled superconducting coils. Measurements are made with two kinds of bridges: mutual inductance and self-inductance bridges. The bridge outputs are combined with other measured voltages to form a detector that can be realized with either analog circuits or a computer algorithm. The detection of a normal zone in a pair of coupled coils, each with taps, is discussed. It is shown that the method applied to a pair of coils when one has no taps and to a pair when one coil is superconducting and the other is not. The method is extended to a number of coils. A technique for balancing the bridges at near the operating currents of the coils is outlined. 8 refs.

31501 Natural circulation in fusion reactor blankets. Gierszewski, P.J.; Mikic, B.; Todreas, N.E. (MIT, Cambridge, Mass). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-69, 1-7(Jul 1980).

The relative importance of natural circulation and heat conduction as heat transfer mechanisms in lithium, sodium and flibe is investigated for a range of magnetic field strengths of interest in fusion reactor blankets. The calculations are based on an order-of-magnitude simplification of the fluid equations, and a modified version of the fission reactor thermal-hydraulic code THERMIT. Preliminary calculations suggest the possibility of a simple flibe blanket module with cooling only along the module boundaries. 16 refs.

31502 First wall thermal hydraulic models for fusion blankets. Fillo, J.A. (Brookhaven Natl Lab, Upton, NY). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-51, 1-8(Jul 1980).

Subject to normal and off-normal reactor conditions, thermal hydraulic models of first walls, e.g., a thermal mass barrier, a tubular shield, and a radiating liner are reviewed. Transient and steady-state conditions are considered. Dominant modes of heat transfer are conduction, convection, and thermal radiation. 20 refs.

31503 Heat transfer in inertial confinement fusion reactor systems. Hovingh, J. (Lawrence Livermore Lab, Calif). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-63, 1-7(Jul 1980).

The short time and deposition distance for the energy from inertial fusion products results in local peak power densities on the order of 10/sup 18/ watts/m/sup 3/. This paper presents an overview of the various inertial fusion reactor designs which attempt to reduce these peak power intensities and describes the heat transfer considerations for each design. 32 refs.

31504 Heat transfer phenomena in gas protected particle beam fusion reactor cavities. Abdel-Khalik, S.I.; Moses, G.A.; Peterson, R.R. (Univ of Wis, Madison). *American Society of Mechanical Engineers, [Paper] ;* No. 80-HT-64, 1-7(Jul 1980).

The behavior of the fireball produced in particle beam fusion reactor cavities as the cavity gas near the target absorbs the X-rays and ionic debris emanating from the microexplosion is examined. Thermal response of the first wall to the radiative heat flux from the gas is examined parametrically. Criteria for the suitability of different cavity fill gases based on their ability to protect the first wall from excessive surface heating and ablation are discussed. 9 refs.

31505 Production of H^- and D^- by backscattering from surfaces. Schneider, P.J. (Univ. of California, Berkeley); Graham, W.G.; Pyle, R.V.; Stearns, J.W. *Institute of Physics, Conference Series ;* No. 54, 171-176(1980).

High-energy (> 200 keV D^0) neutral beam systems for fusion experiments may use negative ion sources in which positive hydrogen ions from a surrounding dense plasma bombard an electrode with a low workfunction, some of them being reflected as negative ions (Ehlers and Leung 1979). In an attempt to understand the mechanism of surface production, we have measured the backscattered H^- and D^- yields in two separate experiments at low and intermediate incident energies. In the low-energy experiment, a hot tungsten tube furnace was used to bombard a molybdenum surface with a flux of low-energy hydrogen atoms. As the surface workfunction was reduced by evaporating Cs onto the target, a small portion (10^{-9}) of the incident hydrogen atoms was observed as backscattered negative ions. In the intermediate energy experiment, H^- and D^- yields were measured for 0.15 to 4 keV/nucleus H_2^+, H_3^+, D_2^+, and D_3^+ bombarding clean targets of Cs, Rb, K, Na and Li. For each taget, the D^- and H^- yields exhibited maxima at incident energies between 300 and 1200 eV/nucleus and always at a lower incident energy for H than for D on a given target. Both the H^- and D^- yields decreased, at any given incident energy, in going from Cs to Li in the order given above. These results are consistent with theoretical treatments.

31506 Generalized analysis of thermal and mechanical loads in inertial confinement reactors. Kramer, J.M. (Argonne National Lab., IL); Meek, C.C.; Predebon, W.W. *Journal of Thermal Stresses ;* **3**: 537-549(1980).

An analysis of thermal and mechanical loads acting on an inertial confinement fusion (or fusion/fission) reactor is presented. It is shown that, as a result of the pulsed mode of operation, quasi-steady-state temperatures and stresses can be separated into static and dynamic components. Numerical results are presented for a specific design of a spherical fusion/fission reactor with a lithium-wetted wall. For the purpose of scaling, materials selection, and fatigue damage assessment, approximate formulas for temperatures and stresses are also given.

99 GENERAL AND MISCELLANEOUS

9901 Management

31507 (DOE/CS/20012—T8) Engineering operations management. (Engineering Supervision Co., Los Angeles, CA (USA)). Sep 1976. Contract AC03-76CS20012. 50p. NTIS, PC A03/MF A01. Order Number DE81022871.

The Engineering Operations Management (EOM) system developed by the Engineering Supervision Co. details and integrates the technical requirements, schedules, and budgeted costs of research programs. The EOM system begins with the contractual requirements and the associated Statement of Work (SOW). From the contractual requirements, the specific tasks to be performed are defined in ever-greater detail down to (if needed) the individual person and to his man-hour requirements per specific task. In use, this permits a continuous comparison of planned performance to actual performance to the level of detail necessary, permitting quick and early flagging of problem areas and facilitating appropriate management action to forestall crisis. This is accomplished by quantitative comparison of planned versus actual costs and graphical comparison of the planned versus actual schedules by a technically competent Project Manager in charge of the project. The EOM is a flexible, systems-oriented Project Management and Control system. Management visibility - and, therefore, potential control - is variable, permitting a degree of control as required by each project and/or status of the company. (LCL)

31508 **(DOE/SF/90459—T1) Systems approach to divisional planning: a presentation by the Division of Conservation Research and Technology to the Assistant Administrator for Conservation, ERDA.** (TRW, Inc., McLean, VA (USA). Energy Systems Group; Energy Research and Development Administration, San Francisco, CA (USA). San Francisco Operations Office). Aug 1977. Contract AT03-76SF90459. 24p. NTIS, PC A02/MF A01. Order Number DE81025747.

Visual aids prepared for a presentation on a systems approach to Conservation Research and Technology divisional planning are shown and discussed. Specifically, a Documentation Data Flow Chart, called the N^2 Chart, shows input/output relationships among planning documents and the calls that generate those documents. It also shows how information moves through the government from the lowest level to the highest, and how guidance moves in the opposite direction. The Annual Planning Activity Schedule, or 13-Month Chart, shows more than the previous chart when each document is prepared, how it moves through consolidation steps, and what planning time-frame is addressed in each planning document. An analysis of what kinds of information went into each document is represented by the Information Element Matrix. The writing of the Branch Plan Specification is described and a project procedure of deciding which projects ought to go into a Branch Plan are explained. Changes in specifications and benefits of the Branch Plan are indicated. (MCW)

31509 **(UCRL—52000-81-7) LLNL 1981: technical horizons.** (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Contract W-7405-ENG-48. 49p. NTIS, PC A03/MF A01. Order Number DE81028265.

Research programs at LLNL for 1981 are described in broad terms. In his annual State of the Laboratory address, Director Roger Batzel projected a $481 million operating budget for fiscal year 1982, up nearly 13% from last year. In projects for the Department of Energy and the Department of Defense, the Laboratory applies its technical facilities and capabilities to nuclear weapons design and development and other areas of defense research that include inertial confinement fusion, nonnuclear ordnances, and particle-beam technology. LLNL is also applying its unique experience and capabilities to a variety of projects that will help the nation meet its energy needs in an environmentally acceptable manner. A sampling of recent achievements by LLNL support organizations indicates their diversity. (GHT)

31510 **Coping with fluctuating demand for professional staff: a prescription and examples.** Lorber, H.W. (Los Alamos Scientific Lab., NM). *Interfaces ;* **9**: No. 5, 81-89(Nov 1979).

Since professionals tend to be highly paid and slow to recruit and train, the professional staffing problem is nontrivial, vexatious, and persistent. Predictions help little when changes in demand are unforeseeable, but two practical planning policies tend to make serious miscalculations unlikely. Dynamic-simulation experiments on an actual technical-service company show that the solution is simply to (1) be generous with overtime in response to backlog, and (2) hire or fire in a timely manner, but sparingly. A simple verbal analysis, comparison with actual data, and an application to a manufacturing firm support the above results.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 29955, 30076, 31262, 31382, 31427, 31440

31511 **(DOE/ER/10473—2) Data-flow computer architecture. Annual technical progress report, July 1, 1980-June 30, 1981.** Dennis, J.B. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Computer Science). 1981. Contract AC02-79ER10473. 7p. NTIS, PC A02/MF A01. Order Number DE81028310.

Research is reviewed in these areas: data flow source language; construction of an engineering model; program translation; data structures; architecture description and simulation; and specification of a full-scale data flow processor. (GHT)

31512 **(DOE/ER/70019—T2) Myopia, cornucopia, and utopia.** Bellman, R. (University of Southern California, Los Angeles (USA)). 7 Oct 1970. Contract AT03-76ER70019. 8p. NTIS, PC A02/MF A01. Order Number DE81026103.

31513 **(DOE/ER/70019—T10) Addition chains.** Kato, H. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Jan 1970. Contract AT03-76ER70019. 72p. NTIS, PC A04/MF A01. Order Number DE81026127.

An addition chain is a sequence of positive integers which provides an optimal procedure for obtaining a power of an associative operator. The determination of shortest addition chains is an unsolved problem in mathematics. A great deal of effort has been devoted to it. The emphasis in this dissertation is upon deriving feasible algorithms for finding suboptimal chains. This became an area of great interest with the invention of highspeed digital computers. Various methods are described and compared in this disseration with respect to both memory requirement and computation time. Fibonacci sequences and binary sequences are studied together with several variations. Extensive use of the computer is also made to assist the theoretical work. Power raising operations form a significant fraction of algorithmic function of a digital machine. Not only are direct application of the results to power raising algorithms given but also some associated uses of the idea are discussed in this dissertation. Some generalizations of an addition chain are briefly mentioned; a multidimensional case, a complementary method and a three-register case.

31514 **(DOE/ER/70019—T14) Initial-value problems in potential theory.** Angel, E.; Jain, A.; Kalaba, R. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Apr 1970. Contract AT03-76ER70019. 15p. NTIS, PC A02/MF A01. Order Number DE81025717.

Potential theory characteristically leads to partial differential equations under boundary conditions. It is shown that these boundary value problems can be converted directly into equivalent initial value problems. These initial value problems are shown to lead to a number of standard and nonstandard numerical procedures.

31515 **(DOE/ER/70019—T15) Bounds for approximate solutions to the operator differential equation Y(t) = M(t)Y(t); applications to Magnus expansion and to ii[1+f(t)]u = 0.** Wilcox, R. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Mar 1970. Contract AT03-76ER70019. 33p. NTIS, PC A03/MF A01. Order Number DE81025718.

31516 **(DOE/ER/70019—T16) Norbert Wiener prize acceptance speech.** Bellman, R. (University of Southern California, Los Angeles (USA)). Sep 1970. Contract AT03-76ER70019. 7p. NTIS, PC A02/MF A01. Order Number DE81026102.

31517 (DOE/EV/04733—T1, pp 35-42) **Proximity function for ^{60}Co. A calculation based on variance results.** Zaider, M. Jul 1981. NTIS, PC A14/MF A01.

In Radiation physics, biophysics and radiation biology. Progress report, October 1, 1980-September 30, 1981.

The calculation of the proximity function, using two algorithms described previously, for a set of experimental data for Cobalt 60 is presented. This calculation requires that a smooth functional fit be provided for the experimental data. As with any functional pit to experimental data a certain bias is introduced depending on the particular analytical expression chosen. To achieve the least biased analytical representation of the data, a general smoothing procedure, based on a B-spline fit, is applied and described. The variance data are also analyzed using this technique. (KRM)

31518 **(LA-UR—81-2052) Application of computer voice input/output.** Ford, W.; Shirk, D.G. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 7p. (CONF-810706—27). NTIS, PC A02/MF A01. Order Number DE81028769.

From Institute of Nuclear Materials Management conference; San Francisco, CA, USA (13 Jul 1981).

The advent of microprocessors and other large-scale integration (LSI) circuits is making voice input and output for computers and instruments practical; specialized LSI chips for speech processing are appearing on the market. Voice can be used to input data or to issue instrument commands; this allows the operator to engage in other tasks, move about, and to use standard data entry systems. Voice synthesizers can generate audible, easily understood instructions. Using voice characteristics, a control system can verify speaker identity for security purposes. Two simple voice-controlled systems have been designed at Los Alamos for nuclear safeguards applicaations. Each can easily be expanded as time allows. The first system is for instrument control that accepts voice commands and issues audible operator prompts. The second system is for access control. The speaker's voice is used to verify his identity and to actuate external devices.

31519 **(LA-UR—81-2265) PLOT2K: a graphics interface to System 2000.** Creel, L. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 7p. (CONF-810930—1). NTIS, PC A02/MF A01. Order Number DE81028706.

From ASTUTE conference; New Orleans, LA, USA (Sep 1981).

PLOT2K is an interactive graphics interface to the System 2000 data base management system. It runs on a CDC 6600 computer with an NOS or NOS/BE operating system. The graphics package used is DISSPLA. PLOT2K will generate bar chart histograms, pie charts, or x-y point plots and will access any System 2000 data base.

31520 **(ORNL/CSD—83) Moment ($\sqrt{b_1}$, b_2) techniques.** Bowman, K.O.; Shenton, L.R. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 70p. NTIS, PC A04/MF A01. Order Number DE81029100.

Topics covered include normal distribution; non-normal sampling; moments of sample momets; the correlation between $\sqrt{b_1}$ and b_2; simultaneous behavior of $\sqrt{b_1}$ and b_2; a bivariate model; and experimental samples. (GHT)

31521 **(SAND—81-0630) UGRAPH user's manual.** Grady, L.M.; Chapman, L.D. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 65p. NTIS, PC A04/MF A01. Order Number DE81028188.

The use of a FORTRAN program entitled UGRAPH is described which permits the user to input lines of text in an interactive fashion and converts this input to drawn text on the screen of a Tektronix terminal. UGRAPH utilizes the DISSPLA graphics subroutines and permits a variety of character and alphabet styles. The in-line instruction capabilities of DISSPLA are also available. UGRAPH allows the user to create, modify, recall, save, or delete viewgraphs from the user's file space on the CDC 6600 time-sharing system. The major advantage of UGRAPH lies in its ease of utilization through the interactive mode.

31522 **(UCID—19166) Decentralized stochastic control and estimation.** Krtolica, R.; Siljak, D.D. (Lawrence Livermore National Lab., CA (USA)). 1 Jul 1981. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01. Order Number DE81028491.

This report discusses a technique to design state estimators for large dynamic systems. A decentralized procedure based on a piece by piece construction using local subsystems to develop the overall estimator/controller is discussed. Results are applicable to the control and state estimation problems.

31523 **(UCLA—10P14-122) Algebraic properties of operator precedence languages.** Crespi-Reghizzi, S.; Martin, D.F. (California Univ., Los Angeles (USA). Dept. of Computer Science; Politecnico di Milano (Italy). Ist. di Elettrontecnica ed Elettronica). Sep 1973. Contract AT03-76SF80073. 54p. NTIS, PC A04/MF A01.

This paper presents new results on the algebraic ordering properties of operator precedence grammars and languages. This work was motivated by, and applied to, the mechanical acquisition and inference of operator precedence grammars. The primary linguistic data upon which the grammatic inference algorithm operates consists of example sentences, example nonsentences, and structural descriptions of example sentences. The inference algorithm, based upon the algebraic properties discussed herein, constructs an operator precedence grammar which generates the largest language consistent with the primary linguistic data. Such grammars, called free grammars, constitute a special subclass of operator precedence grammars. A new normal form of operator precedence grammar, called homogeneous, is defined. Homogeneous grammars enable operator precedence grammars to be ordered according to their weak generative power. It is shown that operator precedence languages corresponding to a given precedence matrix form a Boolean algebra.

31524 **(JPRS—78791) East Europe report: Scientific affairs, No. 711.** (Joint Publications Research Service, Arlington, VA (USA)). 19 Aug 1981. Translation of various articles. 61p. NTIS. Order Number DE81904053.

Topics covered include: a brief review of the activities of the Institute of Nuclear Physics in Albania; the status of computer development; cooperation in computer applications to research; and abstracts in electronics and electrical engineering. (GHT)

31525 **Analysis of a cylindrical shell vibrating in a cylindrical fluid region.** Chung, H.; Turula, P.; Mulcahy, T.M.; Jendrezejczyk, J.A. (Argonne National Lab., IL (USA). Components Technology Div.). *Nuclear Engineering and Design ;* **63**: No. 1, 109-120(Jan 1981).

Analytical and experimental methods are presented for evaluating the vibration characteristics of cylindrical shells such as the thermal liner of the Fast Flux Test Facility (FFTF) reactor vessel. The NASTRAN computer program is used to calculate the natural frequencies, mode shapes, and response to a harmonic loading of a thin, circular cylindrical shell situated inside a fluid-filled rigid circular cylinder. Solutions in a vacuum are verified with an exact solution method and the SAP IV computer code. Comparisons between analysis and experiment are made, and the accuracy and utility of the fluid-solid interaction package of NASTRAN is assessed.

31526 **Methodology for design of digital systems: supported by SARA at the age of one.** Estrin, G. (Univ. of California, Los Angeles). Contract BY-76-S-03-0034. *AFIPS (American Federation of Information Processing Societies), Conference Proceedings ;* **81**: No. 116, vp(1978).

Efforts toward computer-aided design of computers are described. A design methodology is discussed first. It can be characterized as requirement-driven and supportive of self-documenting design of modular, concurrent, hardware, and software systems. A flow chart indicates the processes of initialization, partition (or composition) and its evaluation, and implementation. Then the SARA (System ARchitect's Apprentice) system, a system implemented to support a designer attempting to use the methodology mentioned above, is described. Topics discussed include the user interface, structural and behavioral modeling tools, the design library, behavioral-structural mapping, and multilevel modeling. 7 figures, 2 tables. (RWR)

9903 Information Handling

REFER ALSO TO CITATION(S) 29897, 30769, 31026, 31406, 31473

31527 **(DOE/SF/01182—T7) Techniques for evaluating workshops.** Reynolds, R. (TRW, Inc., McLean, VA (USA). Energy Systems Group). Sep 1977. Contract AM03-76SF01182. 38p. NTIS, PC A03/MF A01. Order Number DE81025748.

The study focuses on workshop types (designated as Type IV) where groups of people from several or many organizations are brought together to synthesize their knowledge or their opinions into a plan, projection, evaluation, or some other collective product. The primary flow of information is inward. A set of recommendations for ways to evaluate workshops sponsored by the Division of Conservation Research and Technology is presented. (MCW)

31528 **Data handling for science and technology.** Rossmassler, S.A.; Watson, D.G. (eds.). Contract AC02-76IR02849. Amsterdam, The Netherlands; North-Holland Publishing Company (1980). 198p. (DOE/IR/02849—T1). Elsevier North-Holland, Inc., New York, NY.

The text includes articles on: data generation; treatment of data in the biosciences; treatment of observational data in the geosciences, estimation and approximation of data; analysis and interpretation of data; presentation of data in the primary literature; access to data in the primary literature; compilation and evaluation of data; standards and guidelines for data; use of computers in handling of laboratory data; accessibility and dissemination of data; national and international data programs; the UNESCO general information program, UNISIST program activities; and CODATA and CODATA conferences. (GHT)

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In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (DOE/TIC-4585) is used in the standardization of corporate entries. DOE/TIC-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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Preliminary design study of underground pumped hydro and compressed-air energy storage in hard rock. Volume 12. Plant design: CAES. Final report, 6:30655 (EPRI-EM—1589-Vol.12)
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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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AC03-76ER00511	**Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy**	
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AC03-76ET10424	**Boeing Engineering and Construction Co., Seattle, WA (USA)**	
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AC03-76ET20417	**McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)**	
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AC03-76SF00012	**California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology**	
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AC03-76SF00515	**Stanford Linear Accelerator Center, CA (USA)**	
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AC03-76SF00948	**Physics International Co., San Leandro, CA (USA)**	
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AC03-76SF01123	**AiResearch Mfg. Co., Phoenix, AZ (USA)**	
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AC03-76SF01284	**Southern Methodist Univ., Dallas, TX (USA)**	
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AC03-77CS40020	**Varigas Research, Inc., Timonium, MD (USA)**	
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AC03-77CS40021	**Systems Control, Inc., Palo Alto, CA (USA)**	
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AC03-77CS69001	**Ragan (James) Associates, Pacific Palisades, CA (USA)**	
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AC03-77SF90506	**Sanders Associates, Inc., Nashua, NH (USA). Defensive Systems Div.**	
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AC08-76EV00703	**Hawaii Univ., Honolulu (USA). Office of Research Administration**	
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1	6:31379	*See* DOE/ET/05007-16
CONF-8009170-		(American Public Power Association energy management and communications workshop, Myrtle Beach, SC, USA, 30 Sep-2 Oct 1980)
2	6:30767	Washington, DC; American Public Power Association (1980).
CONF-8010129-		(Solar central receiver semi-annual meeting, San Francisco, CA, USA, 15 Oct 1980)
	6:30178	*See* SAND-80-8049
	6:30179	*See* SAND-80-8049
	6:30180	*See* SAND-80-8049
	6:30181	*See* SAND-80-8049
	6:30182	*See* SAND-80-8049
	6:30183	*See* SAND-80-8049
	6:30184	*See* SAND-80-8049
	6:30185	*See* SAND-80-8049
	6:30186	*See* SAND-80-8049
	6:30187	*See* SAND-80-8049
	6:30188	*See* SAND-80-8049
	6:30189	*See* SAND-80-8049
	6:30190	*See* SAND-80-8049
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	6:30194	*See* SAND-80-8049
	6:30195	*See* SAND-80-8049
	6:30196	*See* SAND-80-8049
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	6:30265	*See* SAND-80-8049
	6:30266	*See* SAND-80-8049
	6:30267	*See* SAND-80-8049
	6:30268	*See* SAND-80-8049
	6:30269	*See* SAND-80-8049
	6:30270	*See* SAND-80-8049
CONF-8010207-		(Independent Battery Manufacturers Association 1980 convention, Chicago, IL, USA, 15-17 Oct 1980)
	6:30670	Largo, FL; Independent Battery Manufacturers Association, Incorporated (1981).
CONF-801103-		(IEEE nuclear science symposium, Orlando, FL, USA, 5-7 Nov 1980)
62	6:31134	*See* HEDL-SA-2171
CONF-801111-		(6. conference on application of accelerators in research and industry, Denton, TX, USA, Nov 1980)
50	6:31023	*See* DOE/EV/10405-4
CONF-801178-		(SOLTECH conference, Bahrain, Bahrain, 10-11 Nov 1980)
	6:30118	NTIS (US Sales Only), PC A08/ MF A01. Order Number DE81901931, Distribution Category MN -59c
	6:30119	NTIS (US Sales Only), PC A08/ MF A01

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CONF-8011100-		(International scientific forum on geopolitics of energy, Ft Lauderdale, FL, USA, 13 Nov 1980)
1	6:31493	*See* UCRL-85137
CONF-801229-		(Topical meeting: the recovery of uranium from sea water, Cambridge, MA, USA, 1-2 Dec 1980)
	6:30005	*See* GJBX-212-81
	6:30006	*See* GJBX-212-81
	6:30007	*See* GJBX-212-81
	6:30008	*See* GJBX-212-81
	6:30009	*See* GJBX-212-81
	6:30010	*See* GJBX-212-81
	6:30013	*See* GJBX-212-81
	6:30014	*See* GJBX-212-81
	6:30015	*See* GJBX-212-81
	6:30016	*See* GJBX-212-81
	6:30017	*See* GJBX-212-81
	6:31024	*See* GJBX-212-81
CONF-810105-		(International geothermal drilling and completions technology conference, Albuquerque, NM, USA, 21-23 Jan 1981)
	6:30285	*See* SAND-81-0036C
	6:30286	*See* SAND-81-0036C
	6:30297	*See* SAND-81-0036C
	6:30298	*See* SAND-81-0036C
	6:30299	*See* SAND-81-0036C
	6:30350	*See* SAND-81-0036C
	6:30351	*See* SAND-81-0036C
	6:30352	*See* SAND-81-0036C
	6:30353	*See* SAND-81-0036C
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	6:30371	*See* SAND-81-0036C
	6:30372	*See* SAND-81-0036C
	6:30373	*See* SAND-81-0036C
CONF-810150-		(International plasmid conference, Santo Domingo, Dominican Republic, 5-9 Jan 1981)
1	6:31254	*See* DOE/EV/03941-57
CONF-810151-		(Portland Cement Association conference on manufacturing process, Albuquerque, NM, USA, 14-15 Jan 1981)
1	6:30879	*See* IS-M-321
CONF-810226-		(2. DOE/NASA wind turbine dynamics workshop, Cleveland, OH, USA, 24-26 Feb 1981)
	6:30416	*See* SERI/CP-635-1238
	6:30417	*See* SERI/CP-635-1238
	6:30418	*See* SERI/CP-635-1238
	6:30419	*See* SERI/CP-635-1238
	6:30420	*See* SERI/CP-635-1238
	6:30421	*See* SERI/CP-635-1238
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	6:30463	*See* SERI/CP-635-1238
	6:30464	*See* SERI/CP-635-1238
CONF-810249-		(DOE hot gas cleanup contractor's meeting, Morgantown, WV, USA, 3-5 Feb 1981)
	6:29834	*See* DOE/MC/08333-167
	6:29835	*See* DOE/MC/08333-167
	6:29884	*See* DOE/MC/08333-167
	6:29885	*See* DOE/MC/08333-167
	6:29893	*See* DOE/MC/08333-167
	6:29916	*See* DOE/MC/08333-167
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	6:29919	*See* DOE/MC/08333-167
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	6:30508	*See* DOE/MC/08333-167
	6:30509	*See* DOE/MC/08333-167
	6:30510	*See* DOE/MC/08333-167
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	6:30528	*See* DOE/MC/08333-167
	6:30529	*See* DOE/MC/08333-167
	6:30530	*See* DOE/MC/08333-167
	6:30531	*See* DOE/MC/08333-167
CONF-810353-		(Solar desalination workshop, Denver, CO, USA, 23-25 Mar 1981)
(Vol.2)	6:30245	*See* SERI/CP-761-1077(Vol.2)
(Vol.2)	6:30246	*See* SERI/CP-761-1077(Vol.2)
CONF-810367-		(Fuze section annual meeting (ADPA), San Diego, CA, USA, 17-18 Mar 1981)
2(Rev.1)	6:31154	*See* UCRL-85730-Rev.1
CONF-810376-		(16. rencontre de moriond: nonperturbative QCD: theory and experiment, Les Arcs, France, 15-27 Mar 1981)
4	6:31388	*See* BNL-29769
CONF-810386-		(American Crystallographic Association meeting, College Station, TX, USA, Mar 1981)
1	6:31000	*See* DOE/ER/01198-135
CONF-810388-		(AWRE/SNLA/DNA joint conference, Aldermaston, UK, 6-8 Mar 1981)
1	6:31136	*See* SAND-81-1578C
CONF-810429-		(Conference on optics, Santa Fe, NM, USA, 6-10 Apr 1981)
37	6:31485	*See* LA-UR-81-2204
CONF-810496-		(4. international colloquium on photon-photon interactions, Paris, France, 6-9 Apr 1981)
2	6:31373	*See* SLAC-PUB-2747
CONF-810528-		(83. symposium on nucleation and crystallization in glasses, Washington, DC, USA, 3-6 May 1981)
9	6:30640	*See* GA-A-16291
10	6:30627	*See* HEDL-SA-2236-FP
11	6:31003	*See* PNL-SA-9101

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CONF-810542-		(Joint meeting of the Institute of Management Sciences and Operations Research Society, Toronto, Canada, 6 May 1981)
5	6:30674	*See* BNL-29881
CONF-810576-		(Topical conference on symmetry aspects of inertial fusion implosions, Washington, DC, USA, 27-28 May 1981)
2	6:31481	*See* LA-UR-81-2141
3	6:31486	*See* LA-UR-81-2263
CONF-8105104-		(5. high energy heavy ion study, Berkeley, CA, USA, 18-22 May 1981)
1	6:31418	*See* LBL-12929
3	6:31392	*See* LBL-12893
CONF-8105105-		(Symposium on electrocatalyis, Minneapolis, MN, USA, 10-15 May 1981)
1	6:30781	*See* BNL-29821
CONF-8105106-		(Governor's conference on expanding the use of coal, Albany, NY, USA, 21-22 May 1981)
1	6:31114	*See* BNL-29303
CONF-8105107-		(Symposium on energy and big building design, Philadelphia, PA, USA, 25-26 May 1981)
1	6:30817	*See* LA-UR-81-2288
CONF-810606-		(American Nuclear Society's annual meeting, Miami Beach, FL, USA, 7-12 Jun 1981)
85	6:31245	NTIS, PC A02/MF A01. Order Number DE81028610, Distribution Category MN -41
86	6:30641	*See* HEDL-SA-2305
88	6:30642	*See* HEDL-SA-2326-FP
90	6:31069	*See* HEDL-SA-2301-FP
CONF-810623-		(24. midwest symposium on circuits and systems, Albuquerque, NM, USA, 29-30 Jun 1981)
12	6:31483	*See* LA-UR-81-2192
CONF-810624-		(22. US symposium on rock mechanics, Cambridge, MA, USA, 29 Jun-2 Jul 1981)
9	6:30038	*See* RHO-BWI-SA-146
CONF-810649-		(4. international conference on nuclei far from stability, Helsignor, Denmark, 7-13 Jun 1981)
13	6:31417	*See* EGG-M-02681
14	6:31416	*See* EGG-M-02581
CONF-810651-		(1981 topical conference on low-energy X-ray diagnostics, Livermore, CA, USA, 8-10 Jun 1981)
3	6:31142	*See* UCRL-85684
4	6:31133	*See* LA-UR-81-2283
CONF-810667-		(Enlarged halden programme group meeting on process computer applications, Fredrikstad, Norway, 14-19 Jun 1981)
2	6:30639	*See* EGG-M-02881
CONF-810684-		(APS conference on shock waves in condensed matter, Menlo Park, CA, USA, 23-25 Jun 1981)
42	6:30931	*See* LA-UR-81-2124
43	6:30932	*See* LA-UR-81-2257
44	6:31425	*See* LA-UR-81-2303
45	6:31042	*See* UCRL-86489
CONF-8106100-		(International conference on laser spectroscopy, Alberta, Canada, 29 Jun-3 Jul 1981)
4	6:31349	*See* LBL-12981
CONF-8106101-		(Symposium on energy and environment, turbomachinery technology, Patras, Greece, 22-26 Jun 1981)
1	6:31351	*See* RFP-3228
CONF-8106105-		(International conference on internal friction and acoustic attenuation of solids, Lausanne, Switzerland, Jun 1981)
1	6:30977	*See* DOE/ER/01198-1357
CONF-8106109-		(Workshop on processing needs and methodology for wastewaters from the conversion of coal, oil shale and biomass to synfuels, Germantown, MD, USA, Jun 1981)
1	6:29898	*See* LA-UR-81-1904
CONF-8106126-		(ASTM Rockwell International corrosion conference, Nashville, TN, USA, 23 Jun 1981)
1	6:30036	*See* RFP-3119
CONF-8106130-		(International conference on modern trends in activation analysis, Toronto, Canada, 14-19 Jun 1981)
1	6:31028	*See* UCRL-86169
CONF-8106133-		(4. international conference on continuum models of discrete systems, Stockholm, Sweden, 29 Jun-4 Jul 1981)
1	6:30910	*See* SAND-81-1139C
CONF-8106135-		(5. annual EPRI geothermal conference, San Diego, CA, USA, 22 Jun 1981)
1	6:30339	*See* EGG-M-03281
CONF-8106137-		(WATERPOWER 1981 conference, Washington, DC, USA, 22-24 Jun 1981)
1	6:30114	NTIS, PC A02/MF A01. Order Number DE81027817, Distribution Category MN -97e
2	6:30111	NTIS, PC A02/MF A01. Order Number DE81027819, Distribution Category MN -97e
4	6:30117	*See* EGG-M-03381
CONF-8106139-		(Symposium on inorganic reaction mechanisms, Detroit, MI, USA, 10-12 Jun 1981)
1	6:31052	*See* BNL-29842
2	6:31342	*See* BNL-29896
CONF-8106140-		(IAU colloquium, Penticton, Canada, 24-26 Jun 1981)
1	6:31325	*See* LA-UR-81-2320
CONF-810706-		(Institute of Nuclear Materials Management conference, San Francisco, CA, USA, 13 Jul 1981)
27	6:31518	*See* LA-UR-81-2052
29	6:30060	*See* LA-UR-81-2159
30	6:30056	*See* AGNS-35900-CONF-129
CONF-810707-		(IEEE conference on nuclear science and space radiation, Seattle, WA, USA, 21-24 Jul 1981)
6	6:31419	NTIS, PC A02/MF A01. Order Number DE81026353, Distribution Category MN -34
7	6:31137	*See* SAND-81-1680C
CONF-810720-		(2. international swarm seminar, Oak Ridge, TN, USA, 22-23 Jul 1981)
2	6:30537	NTIS, PC A02/MF A01. Order Number DE81026349, Distribution Category MN -34A
CONF-810722-		(International symposium on migration in the terrestrial environment of long-lived radionuclides from the nuclear fuel cycle, Knoxville, TN, USA, 27-31 Jul 1981)
7	6:31203	*See* IAEA-SM-257/56
CONF-810726-		(9. international conference on operational research, Hamburg, F.R. Germany, 23 Jul 1981)
2	6:30673	*See* BNL-29747
CONF-810728-		(9. international conference on atomic collisions in solids, Lyon, France, 6-10 Jul 1981)
4	6:31428	*See* UCRL-85778
CONF-810731-		(14. annual technology meeting of international metallographic society, San Francisco, CA, USA, 21-22 Jul 1981)
1	6:30938	*See* MLM-2848(OP)
CONF-810733-		(ASME short course on radioactive waste management for nuclear power reactors and other facilities, Alexandria, VA, USA, 13-17 Jul 1981)
1	6:30024	NTIS, PC A02/MF A01. Order Number DE81026334, Distribution Category MN -70
CONF-810734-		(7. international conference on conduction and breakdown in dielectric liquids, Berlin, F.R. Germany, 27-31 Jul 1981)
1	6:30538	NTIS, PC A02/MF A01. Order Number DE81026515, Distribution Category MN -94d
2	6:31343	NTIS, PC A02/MF A01. Order Number DE81026514, Distribution Category MN -34A
CONF-810738-		(4. SALE program participants meeting, Argonne, IL, USA, Jul 1981)
1	6:30058	*See* HEDL-SA-2432
CONF-810740-		(3. analytical electron microscopy workshop, Vail, CO, USA, 13-17 Jul 1981)
1	6:31016	NTIS, PC A02/MF A01. Order Number DE81027117, Distribution Category MN -34
CONF-810742-		(4. U.S. national conference on wind engineering research, Seattle, WA, USA, 26-29 Jul 1981)
1	6:31186	*See* LA-UR-81-2380
CONF-810801-		(6. international conference on structural mechanics in reactor technology, Paris, France, 17-21 Aug 1981)
52	6:30598	NTIS, PC A02/MF A01. Order Number DE81028880, Distribution Category MN -77
CONF-810802-		(Conference on new and renewable energy sources, Nairobi, Kenya, Aug 1981)
2	6:30769	NTIS, PC A05/MF A01. Order Number DE81028867, Distribution Category STD -98D

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CONF-810804-		(National heat transer conference, Milwaukee, WI, USA, 2-5 Aug 1981)
10	6:30064	NTIS, PC A02/MF A01. Order Number DE81025466, Distribution Category MN -4
11	6:30636	NTIS, PC A03/MF A01. Order Number DE81028571, Distribution Category MN -79p
CONF-810809-		(16. international conference on low temperature physics, Los Angeles, CA, USA, 19-25 Aug 1981)
12	6:31002	*See* LA-UR-81-1664
14	6:30912	NTIS, PC A02/MF A01. Order Number DE81028608, Distribution Category MN -34
CONF-810810-		(SPIE international symposium, San Diego, CA, USA, 24-28 Aug 1981)
11	6:31141	*See* UCRL-85609
12	6:31484	*See* LA-UR-81-2193
15	6:31179	*See* LA-UR-81-2137
17	6:30954	*See* UCRL-86514
19	6:31140	*See* SAND-81-0727C
T3	6:31072	*See* SAND-81-0728C
CONF-810812-		(IECEC conference, Atlanta, GA, USA, 9-14 Aug 1981)
32	6:30805	NTIS, PC A02/MF A01. Order Number DE81028570, Distribution Category MN -95d
33	6:30619	NTIS, PC A02/MF A01. Order Number DE81028607, Distribution Category MN -13
34	6:30863	NTIS, PC A02/MF A01. Order Number DE81028609, Distribution Category MN -95e
35	6:30217	NTIS, PC A02/MF A01. Order Number DE81028569, Distribution Category MN -95d
CONF-810813-		(National American Chemical Society summer meeting, New York, NY, USA, 23-28 Aug 1981)
11	6:30020	*See* DP-MS-81-15
CONF-810814-		(91. national meeting of the American Institute of Chemical Engineers, Detroit, MI, USA, 16-19 Aug 1981)
6	6:29908	NTIS, PC A02/MF A01. Order Number DE81028060, Distribution Category MN -90b
7	6:30560	NTIS, PC A03/MF A01. Order Number DE81028064, Distribution Category MN -70
CONF-810827-		(8. AIRAPT conference and 19. EHPRG conference, Uppsala, Sweden, 17-22 Aug 1981)
2	6:30944	*See* SAND-81-0365C
3	6:31429	*See* UCRL-86485
4	6:30934	*See* LA-UR-81-2367
CONF-810828-		(Conference on high pressure physics, Bad Honnef, F.R. Germany, Aug 1981)
2	6:30953	*See* UCRL-86484
3	6:31426	*See* SAND-81-1074C
4	6:30930	*See* LA-UR-81-2082
5	6:30913	NTIS, PC A02/MF A01. Order Number DE81028572, Distribution Category MN -34
CONF-810831-		(Fusion reactor materials meeting, Seattle, WA, USA, 9-12 Aug 1981)
6	6:30980	*See* LA-UR-81-2078
7	6:31480	*See* LA-UR-81-2140
8	6:31482	*See* LA-UR-81-2161
9	6:30914	NTIS, PC A02/MF A01. Order Number DE81028577, Distribution Category MN -20c
10	6:30915	NTIS, PC A02/MF A01. Order Number DE81028578, Distribution Category MN -20c
13	6:30916	NTIS, PC A02/MF A01. Order Number DE81028574, Distribution Category MN -20c
14	6:30917	NTIS, PC A02/MF A01. Order Number DE81028613, Distribution Category MN -20c
17	6:30933	*See* LA-UR-81-2266
18	6:31475	*See* GA-A-16430
CONF-810832-		(DOE passive and hybrid solar energy program update, Washington, DC, USA, 9-12 Aug 1981)
4	6:30236	*See* LA-UR-81-2209
5	6:30218	NTIS, PC A02/MF A01. Order Number DE81028573, Distribution Category MN -59c
CONF-810833-		(Mechanical, magnetic, and underground energy storage 1981 annual contractors' review meeting, Washington, DC, USA, 24-26 Aug 1981)
3	6:30547	*See* LA-UR-81-2296
6	6:30650	*See* LA-UR-81-2307
CONF-810835-		(1981 cryogenic engineering conference, San Diego, CA, USA, 10-14 Aug 1981)
1	6:31494	*See* UCRL-85580
2	6:30536	*See* BNL-29900
CONF-810836-		(3. international seminar on the containment of fast breeder reactors, Ispra, Italy, 24-25 Aug 1981)
1	6:30643	*See* HEDL-SA-2470
CONF-810837-		(32. meeting of the Aeroballistic Range Association, Karlsborg, Sweden, 12-14 Aug 1981)
1	6:31155	*See* UCRL-86480
CONF-810840-		(Symposium on neutron scattering, Argonne, IL, USA, 12-14 Aug 1981)
1	6:31420	NTIS, PC A02/MF A01. Order Number DE81028576, Distribution Category MN -48
CONF-810907-		(8. international conference on chemical vapor deposition, Gouvieux, France, 15-18 Sep 1981)
1	6:31479	*See* LA-UR-81-1293
CONF-810913-		(International conference on environmental degradation of engineering materials, Blacksburg, VA, USA, 21-23 Sep 1981)
5	6:30911	*See* BNL-29671
CONF-810914-		(International conference on coal science, Dusseldorf, F.R. Germany, 7-9 Sep 1981)
3	6:29768	*See* BNL-29825
CONF-810915-		(32. international astronautical congress, Rome, Italy, 6-12 Sep 1981)
1	6:30617	*See* LA-UR-81-1626
CONF-810916-		(International conference on numerical methods for coupled problems, Swansea, UK, Sep 1981)
1	6:31360	*See* LA-UR-81-1421
CONF-810923-		(7. underground coal conversion symposium, Fallen Leaf Lake, CA, USA, 8-12 Sep 1981)
6	6:29873	*See* UCRL-85919
7	6:29872	*See* UCRL-85839
CONF-810925-		(6. national passive conference, Portland, OR, USA, 8-12 Sep 1981)
7	6:30235	*See* LA-UR-81-2200
8	6:30250	*See* SERI/TP-721-1317
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10	6:30249	*See* SERI/TP-721-1312
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18	6:30253	*See* SERI/TP-721-1332
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2	6:31151	*See* SAND-81-0246C
CONF-810929-		(International measurement confederation conference, Dubrovnik, Yugoslavia, 28 Sep-3 Oct 1981)
1	6:31495	*See* UCRL-86087
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1	6:31519	*See* LA-UR-81-2265
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8910-PR	6:30621	NTIS, PC A04/MF A01. Order Number DE81028596, Distribution Category STD -20d
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